AC 2010-263: ENHANCING ENGINEERING STUDENTS' KNOWLEDGE OF INFORMATION LITERACY AND ETHICS THROUGH AN INTERACTIVE ONLINE LEARNING MODULE

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Enhancing Engineering Students' Knowledge of Information Literacy and Ethics through an Interactive Online Learning Module

Abstract

Enhancing information literacy and ethics awareness has long been recognized as one of the important tasks in engineering education. Current practices of fostering engineering students' information literacy and ethics mainly include formal coursework on information literacy and the seminars given by subject librarians. However, few electrical engineering program core courses strive to enrich students' understanding of information literacy and ethics in the teaching of their respective core contents. In this study, we explore an alternative to the current practices, which is the integration of information literacy and ethics training into core courses. Specifically, we developed an interactive online learning module on information literacy and ethics based on a seminar given by a subject librarian for electrical engineering in spring 2009. The module was delivered, as a course component, in two undergraduate and two graduate core courses in electrical engineering in spring 2009 and fall 2009. Participants were required to take a pretest on the knowledge of information literacy and ethics prior to the start of the module. In addition, they were required to take a posttest after their completion of the module. The effectiveness of this module on students' knowledge of information literacy and ethics was evaluated by the analysis of pretest and post test scores.

Introduction

Information literacy and ethics is a set of abilities requiring individuals to find information effectively, and use information ethically. The abilities to locate and use information properly are crucial for engineering students to complete their coursework, to perform their jobs in engineering, and to become successful lifelong learners. First of all, engineering students need the information literacy skills to conduct literature review for course projects, senior designs, and theses. Second, it is impossible for engineering students to get all solutions to engineering problems from their coursework. Instead, students must be able to find existing solutions or to create new solutions to specific problems from published literature, databases, and library. Third, developing information literacy skills will empower students to control their own learning within and beyond the classroom so that they will become lifelong learners[1].

Information literacy and ethics is one of the important outcomes to achieve in engineering education. The expected student outcomes of Program of Bachelor of Electrical Engineering (PBEE) at Cleveland State University include (f) Understanding of professional and ethical responsibility; (g) Communicate effectively; (j) Knowledge of contemporary issues; (k) Use the techniques, skills, and modern engineering tools[2]. The Master of Science in Electrical Engineering (MSEE) at Cleveland State University also states that it is designed for students to acquire (c) the ability to access and use the literature in one's field; and (d) the ability to communicate effectively[3]. Clearly, electrical engineering students are expected to be familiar with the current standards in information literacy[4], to know how to use the particular library resources available to them, to be able to conduct integrative literature review, to cite

information properly, and to understand what is regarded as cheating and plagiarism practices that they shall avoid.

Current practices of fostering engineering students' information literacy and ethics mainly include stand-alone courses in information literacy (such as Engineering Research Writing[5]), seminars given by subject librarians[1, 6, 7], tutor-training program for ethics education[8], stand-alone courses in ethics[9], and discussion on engineering ethics video[10]. However, few electrical engineering program core courses strive to enrich students' understanding of information literacy and ethics in the teaching of their respective core contents. In this study, we explore an alternative to the current practices, which is the integration of information literacy and ethics training into core courses. Specifically, we developed an interactive online learning module on information literacy and ethics based on a seminar given by a subject librarian for electrical engineering in spring 2009. The module was delivered, as a course component via Blackboard, in undergraduate and graduate core courses in electrical engineering at Cleveland State University.

The design of an Interactive Online Learning Module

The interactive online learning module for information literacy and ethics consists of three major components, namely, audio presentation with slides, interactive self-evaluation tool, and assessment. The audio presentation with slides component (Figure 1) is built on a recorded seminar on information literacy and ethics given by the subject librarian for electrical engineering at Cleveland State University in 2009. In this component, students can listen to audio explanation while reading the slides of information literacy and ethics. Students can also move to the audio portion of a major topic by clicking its slide index. The 48-minute audio presentation discusses major topics in information literacy and ethics including information literacy standards, library use, literature searching, databases, plagiarism, citation styles, and literature reviews. The interactive self-evaluation tool (Figure 2) allows students to reflect on their own learning of this module, and to interact with course instructors directly for any questions or feedbacks, which could lead to further discussions between course instructors and students. The assessment component contains an objective knowledge of information literacy and ethics test. The test is designed to measure students' knowledge and understanding in information literacy and ethics in the multiple-choice test format. The test has 15 items covering major topics in the module.

The interactive online learning module can be easily adapted and integrated into online courses using Blackboard Learning System. Figure 3 shows a possible arrangement of the components of the module in a Blackboard course, in which students must complete the pretest (part of the assessment component) before the audio presentation with slides and self-evaluation tool components will appear. In addition, students must successfully complete the audio presentation with slides and self-evaluation tool components before the posttest (part of the assessment component) will appear.

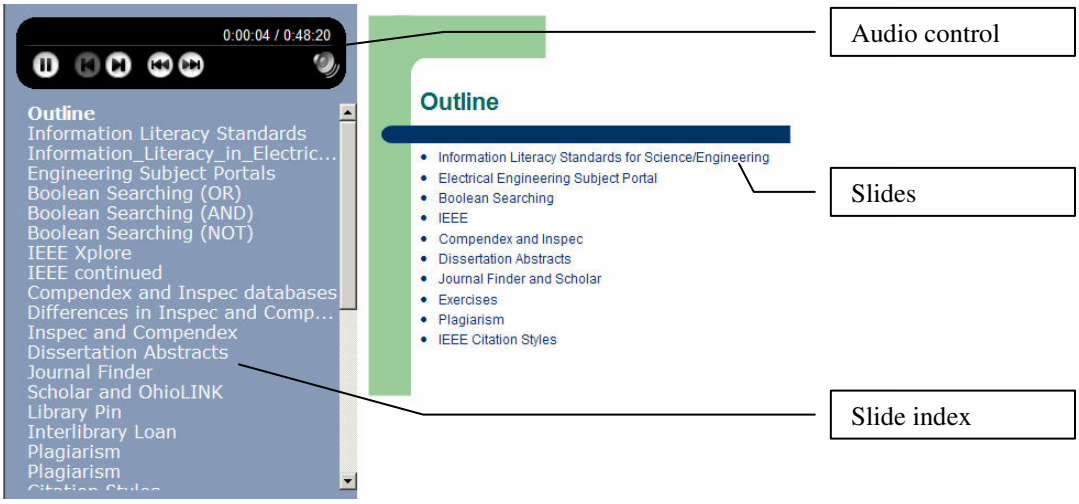

Figure 1: A Screen Shot Example of the Audio Component of the Interactive Online Learning Module for Information Literacy and Ethics.

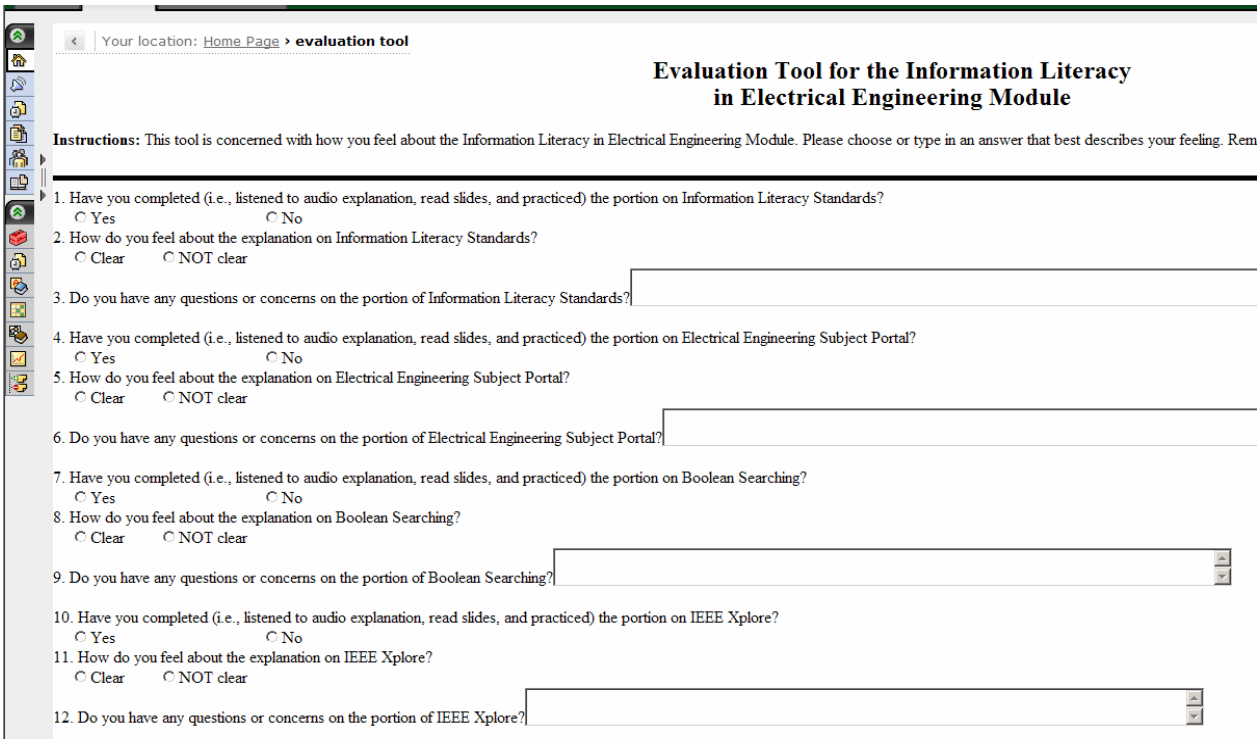

Figure 2: A Screen Shot Example of the Interactive Component of the Interactive Online Learning Module for Information Literacy and Ethics (The Component Is Only Partially Shown).

Figure 3: A Screen Shot Example of the Interactive Online Learning Module for Information Literacy and Ethics.

The primary purpose of this study was to determine the effectiveness of the interactive online learning module for information literacy and ethics. Specifically, our research question is: Are there any changes in participants' test scores of the knowledge of information literacy and ethics test over the period of the study (pretest and posttest)?

Study 1

The first study tested utilized a quasi-experimental pretest-posttest design to examine participants' test scores in the knowledge of information literacy and ethics test in the interactive online learning module condition and in the seminar condition.

Method

Participants: Forty-two students from Cleveland State University participated in study 1 in return for a few bonus course points. Most of the participants were male, white, and in their twenties.

Measures: Information literacy and ethics was evaluated by a 15-item test of Knowledge of Information Literacy and Ethics. A test score (out of 15) will be calculated as the index of student knowledge of information literacy and ethics.

Procedures: Participation was solicited from the students enrolled in two courses (Control Systems, and Dynamics and Control of MEMS) in the spring 2009 semester at Cleveland State University. Institutional Review Board (IRB) approval of the use of human subjects was first

obtained. In the seminar condition, willing participants signed consent form before they took the paper version of the knowledge of information literacy and ethics test (pretest). Students attended a seminar on information literacy given by an engineering subject librarian in a regular class meeting time. One week after the seminar, student participants took the posttest. In the online module condition, willing participants signed consent form in class and were given a detailed instruction sheet and access code to complete the interactive online learning module for information literacy and ethics in Blackboard. Specifically, they were required to complete the online version of the knowledge of information literacy and ethics test first, then the audio presentation with slides component together with the interactive self-evaluation tool component, and finally the posttest. Students were given three weeks to complete this module at their own pace.

Results

The means and standard deviations of the information literacy and ethics test scores of the pretest and posttest for the interactive online learning module condition and the seminar condition were calculated and reported in Table 1. There are differences in means of the information literacy and ethics scores in the two conditions.

Table 1: Means and Standard Deviations of Pretest and Posttest Scores in Two conditions.

	Pretest		Posttest		
	Mean	*SD*	*Mean*	*SD*	*N*
Seminar	10.16	1.92	11.89	1.63	19
Online module	9.60	1.70	12.04	1.99	23

A mixed-model ANOVA was conducted with time as the within-subjects factor (pretest vs. posttest) and condition as the between-subjects factor (seminar vs. online module) on the information literacy and ethics test scores. The time effect was significant $F(1, 40) = 38.25$, $p <. 01$. The effect size (partial eta squared) was .49, which was large. The time × condition interaction effect was not significant. The between-subjects factor (condition) was not significant. Two paired-samples t-tests were conducted to follow up the significant time effect. The results indicated that in the seminar condition, the mean of posttest scores ($M = 11.89$) was significantly greater than the mean of pretest scores ($M = 10.16$), where $t(18) = 4.557$, $p <. 01$. In the online module condition, the mean of posttest scores ($M = 12.04$) was significantly greater than the mean of pretest scores ($M = 9.60$), where $t(22) = 4.635$, $p <. 01$.

Discussion

The ANOVA findings indicated that students in the seminar condition and students in the online module made significant gains in knowledge of information literacy and ethics (the significant time effect). The seminar condition was not significantly different from the online module condition in terms of pretest scores and posttest scores. In other words, the effectiveness of the online module is equivalent to that of the seminar to enrich students' knowledge of information literacy and ethics. Even though our findings are encouraging, we must also acknowledge the limitations of the study. First, our participants were not randomly selected.

Second, the online module was not used in one course. We still need to further study the effectiveness of the interactive online learning module.

Study 2

Study 2 replicated Study 1 using a different sample. Study 2 did not include the seminar condition. It only focused on the effectiveness of the interactive online learning module.

Method

Study 2 employed the same measure as that in Study 1. Study 2 also followed a similar procedure to that in Study 1. In the second study, forty-eight participants were recruited from two different courses (Linear Systems and Electronics II) in fall 2009 to use the interactive online learning module for information literacy and ethics.

Results

The means and standard deviations of the information literacy and ethics test scores of the pretest and posttest were calculated and reported in Table 2. A repeated measure ANOVA was conducted with time as the within-subjects factor (pretest vs. posttest) on the information literacy and ethics test scores to determine whether there were any significant changes in all the participants' test scores of the knowledge of information literacy and ethics test over the period of the study (pretest and posttest). The time effect was significant $F(1, 47) = 53.93$, $p <. 01$. The effect size (partial eta squared) was .534, which was large.

Table 2: Means and Standard Deviations of Pretest and Posttest Scores in Study 2.

	Pretest		Posttest		
	Mean	*SD*	*Mean*	*SD*	*N*
Course 1	9.19	2.36	11.95	2.04	21
Course 2	8.74	3.37	12.07	2.50	27
Combined	8.94	2.95	12.02	2.28	48

Discussion

Results from Study 2 provide evidence that the interactive online learning module for information literacy and ethics is effective in enhancing engineering students' knowledge of information literacy and ethics. This is consistent with the results from Study 1. As discussed earlier, the interactive online learning module is designed as an alternative to the current practices in promoting information literacy and ethics awareness among engineering students. Compared with other known approaches, this interactive online learning module is more flexible and user friendly – students can study at their own pace and in any places.

Conclusion

We tentatively concluded that the interactive online learning module is a valid and effective alternative to teaching information literacy and ethics. However, future work is needed

to consolidate this conclusion. We plan to expand the assessment component of the module by designing a test bank to more accurately measure students' knowledge of information literacy and ethics, and to integrate this interactive online learning module into more core courses in engineering programs.

Bibliography

1. B. A. Smith, L. Whiteman, "Assessment of a Web-based Information Literacy Program for Industrial engineers", in Proceedings of the 2003 American Society for Engineering Education Annual Conference & Exposition, Nashville, TN, 2003.
2. B. MacAlpine, "Engineering + Information Literacy = One Grand Design", in Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition, Portland, Oregon, 2005.
3. B. MacAlpine, M. Uddin, "Integrating Information Literacy Across the Engineering Design Curriculum", in Proceedings of the 2009 American Society for Engineering Education Annual Conference & Exposition, Austin, TX, 2009.
4. B. Williams, P. Blowers and J. Goldberg, "Integrating Information Literacy Skills into Engineering Courses to Produce Lifelong Learners", in Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition, Salt Lake City, UT, 2004.
5. C. Yu, "Program of Master of Science in Electrical Engineering (MSEE) Assessment, Assessment Report and Suggestions", Assessment Report, Department of Electrical and Computer Engineering, Cleveland State University, May 2007.
6. D. McEachron, S. Ake, "A Model for Integrating Ethics Into an Engineering Curriculum", in Proceedings of the 2009 American Society for Engineering Education Annual Conference & Exposition, Austin, TX, 2009.
7. F. Xiong, "Program of Bachelor of Electrical Engineering Assessment Annual Report", Annual Report, Department of Electrical and Computer Engineering, Cleveland State University, May 2007.
8. Information Literacy Standards for Science and Engineering/Technology, The ALA/ACRL /STS Task Force on Information Literacy for Science and Technology, Association of College and Research Libraries.
9. A. Colby, W. M. Sullivan, "Ethics Teaching in Undergraduate Engineering Education", *Journal of Engineering Education*, pp. 327-338, July 2008.
10. M. C. Loui, "Assessment of an Engineering Ethics Video: Incident at Morales", *Journal of Engineering Education*, pp. 85-91, Jan. 2006.