

“Fabulous Fridays”: Satisfying ABET 2000 Criterion I and J in an Optoelectronics Elective

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Abstract

Upper-division undergraduate elective courses are good candidates for implementing ABET 2000 Criteria 3i and j relating to lifelong learning and contemporary issues in Electrical Engineering curricula. At the University of San Diego, students developed skills related to these criteria in an *Optoelectronic Materials and Devices* elective. The criteria are directly addressed in two of the course objectives: to aid the students' professional development by addressing issues such as the ability to critically evaluate technical papers, conduct effective literature research, and express information orally and in writing and to identify at least two current topics in optoelectronics research.

Several innovative pedagogical techniques were integrated into the course to address lifelong learning and contemporary issues. Students explored an area more deeply by conducting literature research including a paper and a presentation on a topic of their choice. Topics ranged from organic LEDs to photonic crystals. In Spring 2003, the last fifteen minutes of each Friday class was devoted to “Fabulous Friday” where one student led a discussion of a recent article which he/she had distributed to the class on Monday. Articles came from sources such as *Laser Focus World* and *IEEE Spectrum*. This endeavor gave the students an opportunity to develop oral communication skills and the ability to critically evaluate new information from sources other than textbooks and lectures. Topics included curing blindness with LEDs and iris scanning for security. Students provided feedback on this process at the end of the semester which resulted in revised instructions for “Fabulous Friday”. This framework may be adapted to any courses where criteria i and j are addressed. Contemporary issues were also incorporated into homework assignments. For example, students evaluated an issue of *Laser Focus World* by reviewing the “Back to Basics” article. Investigating the advertisements helped them learn about the diversity of current products and companies in the optoelectronic industry.

Introduction

There is general agreement from industry¹, students², and faculty³, on the value of learning skills related to ABET Criteria 3i and j on lifelong learning and contemporary issues. The rationale for this is often described in terms of the rapidly developing pace of current technology, the short time available in a standard engineering curriculum, and the need for engineers to be able to adapt to new responsibilities. However, finding appropriate places for addressing these criteria in an electrical engineering (EE) curriculum can be a challenge. Various approaches have been adopted including developing a general education course for engineers⁴, a senior engineering

seminar⁵, providing opportunities outside the classroom⁶, identifying existing courses throughout the curriculum⁷, or incorporating within a core class⁸. Upper-division undergraduate elective courses are good candidates for incorporating these ABET 2000 criteria in EE curricula. This paper describes the implementation of these criteria in such an elective.

In the EE program at the University of San Diego (USD), we have chosen to further define these criteria as

(i) a recognition of the need for and an ability to engage in life-long learning

Students are challenged with problems from which they must independently seek knowledge.

(j) a knowledge of contemporary issues

This outcome is defined by the program to mean knowledge of contemporary issues *within the discipline* of electrical engineering. In this course, contemporary issues focused on *within the field of optoelectronics*.

Although students have a choice of electives, all USD EE electives aim to address criteria i and j. Typically there are about twenty students in junior and senior level required electrical engineering classes at USD. In Fall 2003, eight studentsⁱ enrolled in an elective on *Optoelectronic Materials and Devices* where they developed skills related to these criteria. The criteria are directly addressed in two of the course objectives stated on the course syllabus as:

- to aid the students' professional development by addressing issues such as the ability to critically evaluate technical papers, conduct effective literature research, and express information orally and in writing
- to identify at least two current topics in optoelectronics research

Several innovative pedagogical techniques were integrated into the course to satisfy these objectives. In addition, they address the related ABET criterion g “an ability to communicate effectively” orally and in writing. These activities were integrated into the course as required elements of the course so that their usefulness and relevance to the topics were clear to the students. The two major activities, literature research project and “Fabulous Friday” were discussed on the first day of class. It is important that the students understand the instructor’s expectations regarding these types of assignments and that they are given adequate time to complete them. Thus this course has clear expectations communicated to the students, encourages students to take responsibility for their learning in several ways including leading a discussion, presenting information, and conducting literature research, and provides motivation for students by having them do activities that are fun and nontraditional. All of these aspects fit in with the strategies for developing lifelong learning described by Parkinson⁶ and McCombs⁹.

Course Activities Related to Lifelong Learning and Contemporary Issues

Literature Research Project: Paper and Presentation

Students explored an area more deeply by writing and presenting a paper on a topic of their choice. Multiple opportunities for peer review and criticism are provided to help students develop their communication skills as well as requiring them to think at the highest level of Bloom’s taxonomy “Evaluation”¹⁰. As Mourtos⁷ describes, operating at these higher levels is

ⁱ Due to the limited availability of laboratory facilities, the enrollment is capped at eight students.

essential for developing lifelong learning skills. Students chose topics ranging from organic LEDs to lasers in medicine to photonic crystals to free space communication systems. In the syllabus distributed on the first day of class, the parameters of this project were described (presentation to class and written report: 6-10 pages typed, cover sheet, appropriate documentation of multiple references). To enhance the quality of the final product, interim deadlines were provided. About four weeks into the class, students submit a topic and state why they chose this topic, one thing they know about it, one thing they want to investigate, and give appropriate citations for at least two references. About four weeks later, they submit an outline identifying the specific topics to be discussed. Three weeks later, a draft of the paper is due. It must be in the format of the final paper and is peer reviewed in class on the day it is submitted. Final papers are due two weeks later or about 1.5 weeks before the semester ends to allow time for the instructor to grade and return the papers on the last day of class. The final paper due date is also the first day of presentations.

Each student presents for about thirty minutes including questions with two students presenting per fifty-five minute class period. About one month before the end of the semester, students sign up for a presentation date and a consultation with the instructor a few days before their presentation date. Students are instructed to bring copies of their slides to this meeting so that the instructor can provide useful feedback. Students peer review each other's presentation and the instructor provided a summary for each student including comments from peers and instructor and grades for content and presentation from peers and instructor. Most students did very well on the presentation with grades ranging from 75 to 100%. The grading by the instructor and the students was quite consistent with the average grades being within 4% of each other. All students used PowerPoint. Some students included demonstrations, mini-lectures on the board, candy rewards, or interactive questions. Each presenter also prepared two questions with answers based on their presentation for possible use on the final exam. They were encouraged to share these with their classmates either during or after their presentation. These questions were intended to help the students focus their presentations and make their expectations clear for their classmates similar to learning objectives for a course. After some editing by the instructor, a multiple choice question based on each presentation was included on the final exam. Students generally do well on this section of the final exam. Having the students take responsibility for their own learning and that of their classmates helps them develop lifelong learning skills. Copies of all documentation used for this project are available from the author.

“Fabulous Fridays”

In Spring 2003, the last fifteen minutes of each Friday class was devoted to “Fabulous Friday” where one student led a discussion of a recent article which he/she had distributed to the class on Monday. During the first week of class, the instructor distributed and discussed the guidelines for “Fabulous Fridays” and students signed up to be the leader for a specific Friday during the semester. Instructions given to students included

- Find an interesting article. Sources such as *Scientific American*, *IEEE Spectrum*, *Laser Focus World*, *Business Week* might be good places to start.
- Provide 9 copies of the article for us to read by the Monday before your Friday (if you have it ready by the previous Friday, I can have copies made)

- Email a brief summary of your article and at least 2 discussion questions by Thursday at noon to slord@sandiego.edu
- Lead the discussion on your Friday

Articles came primarily from *Laser Focus World* and *IEEE Spectrum*. This endeavor gave the students an opportunity to develop oral communication skills and the ability to critically evaluate new information from sources other than textbooks and lectures. Topics included applications of LEDs for curing blindness, iris scanning for security, and thin-film photovoltaics. Some students used their “Fabulous Friday” topic as their literature research topic. Some did outside research to enhance their discussions. Students enjoyed the range of topics. Leading a discussion was challenging for many including the instructor as she strives to balance her own participation, providing context or background, and letting the students lead.

“Fabulous Friday” was a required part of the course. It counted as one homework assignment. The instructor graded this assignment out of 10 points with 2 points for finding an article, 1 point for distributing it, 2 points for their questions, 2 points for the summary and 3 points for leading the discussion. Given that there were more weeks in the semester than students in the class, the instructor initially planned on leading the discussions herself during the remaining weeks. After the students signed up during the first week of class, the extra weeks occurred late in the semester. As the semester progressed, several students expressed a desire to lead an additional “Fabulous Friday” as a way to earn extra credit for the course or to improve their performance over their first “Fabulous Friday”. Students were given the opportunity to do another “Fabulous Friday” for up to five extra credit points. For the two students who led two discussions, their discussions were more dynamic the second time.

Homework

As would be expected in a senior elective, many homework problems related to contemporary issues in optoelectronics including white LEDs, vertical cavity surface emitting lasers (VCSELs), and blue light emitters. Contemporary issues and lifelong learning were directly addressed more innovatively in the first homework assignment where students evaluated an issue of *Laser Focus World*. They reviewed the "Back to Basics" article in their issue and identified the section that they found most interesting. They were asked to “Summarize the content of this article in your own words using complete sentences. Then comment on how readable, understandable, interesting, and useful the article is. Would it be a good article for future EEE 194 students to read? Why or why not?” Investigating the advertisements helped them learn about the diversity of current products and companies that make up the modern optoelectronic industry. It also forced them to look at a magazine that they might have initially found intimidating and helped to build up some confidence in their own ability to learn from such sources. Students were also asked (as an extra credit question) to comment on how useful this homework assignment was to them. Sample student comments show that the students are reading critically while gaining confidence and new knowledge. These are several of the attributes described by Mourtos as measures of achieving lifelong learning skills.⁷

As engineers, we have to weed through a lot of material to get to what is important. I thought this was a good example of that weeding out process. I read the Back to Basics article completely, but I found myself only scanning some articles. They were just too full of technical jargon and what appeared to me as meaningless data.

I now fear such magazines a little less. Before now, my Spectrums were indeed dust collectors, but now I am looking forward to flipping through the next issue.

I enjoyed this assignment because it was not a textbook assignment. It was a like a field trip for me because I had fun and learned something at the same time.

I believe that this homework problem will be very useful to me...I am able to read, express an interest in an article, and am able to relate what I have learned in school to something in real life. Very often, I feel that my education is not teaching me anything that I will use in real life, but this article helps to put things in perspective.

In homework one, the students were also asked to provide an example of where they use optoelectronics in their everyday life including explaining why optoelectronics is necessary or desirable and as much as they could about how the product/system works. Examples that students used included DVD players, LEDs for stoplights, garage door openers, and safety systems. This exercise helps them connect the course material to their experience in a fun way and helps build student confidence and responsibility for their learning, key features of lifelong learning.

Student Response and Revision

Student response to the class was quite enthusiastic as may be expected for a small elective course. Although students worked hard, they believed they learned a lot which made it worthwhile. On the end of the semester evaluations, two of the eight students specifically mentioned “Fabulous Fridays” as an aspect of the class that contributed the most to their learning. Several students commented that the book was too “intimidating” and could be improved. The textbook is a challenge for a course which covers contemporary issues such as optoelectronics where the field is changing rapidly. For example, topics such as white LEDs are not covered in most textbooks but are now commonly available commercially. Thus it is crucial for the instructor to supplement the textbook with recent articles or other materials and incorporate activities such as those described in this paper that facilitate having the students bring in current issues as well. Perhaps the students in this elective were more critical of the textbook after having seen other sources of information in their literature research and “Fabulous Fridays”.

An excellent example of the students demonstrating the use of skills related to lifelong learning is their participation in identifying ways to improve the “Fabulous Friday” process. Throughout the course of the semester, articles tended to get shorter until one very short one proved difficult to understand due to the lack of details provided. The class recognized this and discussed the criteria for a suitable article and subsequent articles were more appropriate. During an informal midcourse evaluation all students commented on the value of and/or made suggestions on how to improve “Fabulous Fridays” in response to the questions “What do you like best about the course? What needs improvement? How could the course be improved?”

Fabulous Fridays should be more specific. I would suggest a more targeted list of topics. Our idea of exciting and interesting is often quite different than information that is applicable to course.

I like Fabulous Friday. It is a good change. We can see how the stuff we learned in class is being used in the real world.

Fabulous Fridays are going well. Again, maybe tell the students that you're looking for the slightly longer articles with more content.

Based on these suggestions, changes were made to the instructions on “Fabulous Friday” to include more details on the type of article that would be suitable (length, related to a topic discussed in class) and the requirements for the summary. The date the summary was due was changed from a Thursday, when the class did not meet, to a Wednesday when the class did meet. The students said this would help them to remember to do it. The instructor made changes to the guidelines and distributed them to the class for one more round of feedback. The new instructions as shown in Appendix A are ready for the next offering of the course or other courses where such an activity might be useful.

The framework developed for “Fabulous Friday” may be used in any course where it is beneficial for students to investigate current topics. Depending on factors such as the amount of course time available, course structure, number of students, it could be adapted so that students present in groups, several students lead fifteen minute discussions during the same class period, or it is used as an extra credit assignment. For example, the instructor subsequently used a modified version of this activity in a junior level Materials Science course where students had to identify one article related to current issues preparing copies and a summary according to the “Fabulous Friday” guidelines but the discussions were all held during the last week of class. The class voted on which days to discuss which articles. Adding self-assessment of the literature research project and the “Fabulous Friday” assignment would be helpful for further enhancing the development of lifelong learning skills. In addition, having students reflect on their own learning process as they did these activities could be useful.

Summary

ABET outcomes i and j related to lifelong learning and contemporary issues were incorporated into a senior undergraduate elective course on optoelectronic materials and devices at USD. These activities included a literature research project with a paper and presentation, “Fabulous Friday” discussions, and homework assignments. Students developed skills by choosing their own topics, learning about new developments in optoelectronics from sources such as magazines and trade journals, presenting and discussing new topics with classmates, reviewing their peers’ written and oral communication, and participating in reviewing and revising their own process. The framework developed for “Fabulous Fridays” may be adapted to any course aimed at addressing contemporary issues and lifelong learning. Student response to the class was very positive indicating that they found it challenging but worthwhile.

Acknowledgements

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Appendix A: Revised “Fabulous Friday” guidelines including suggestions from students.

TO: Students in EEE 194
FROM: Dr. S. M. Lord
DATE: May 12, 2003 REVISED
RE: *Fabulous Fridays*: Current Topics in Optoelectronics

The field of optoelectronics is currently evolving at a fast rate. To allow us to explore some of the newer topics, I would like to spend the last 15 minutes of class each Friday discussing a recent article concerning optoelectronics. We’ll take turns doing this. Please sign up for a week to lead the discussion. Note that it is important that we all read the articles each week so we can discuss them.

When it is your turn, you must

1. Find an interesting article related to a topic we have discussed in class. Sources such as *Scientific American*, *IEEE Spectrum*, or *Laser Focus World* might be good places to start. Pick an article with enough information to provide for good discussion. (Articles of several pages are probably more suitable than newsbriefs.)
2. Provide 9 copies of the article for us to read and at least 2 discussion questions by the Monday before your Friday (if you have it ready by the previous Friday, I will make copies). You can email the questions to your classmates.
3. Email a brief summary of your article with your discussion questions by Wednesday at noon to slord@sandiego.edu. Your summary should include a complete citation for your article, an explanation of the main system/technology/device/process described in your article as well as its advantages and disadvantages. Highlight any new terms that might not be familiar to your classmates. Explain how this topic is related to those discussed in EEE 194.
4. Lead the discussion on your Friday. You may need to do some additional research to help with this.

You are welcome to come and talk about the article before your Friday if you want.

This will count as one of your homework assignments for the semester. However, you MUST do this one i.e. it can not be one of the homework assignments that you drop.

Name	Copies distributed	Discussion
	Monday, February 3, 2003	Friday, February 7, 2003
	Monday, February 10, 2003	Friday, February 14, 2003