

AC 2008-684: MINORS IN ENGINEERING STUDIES: TEACHING TECHNOLOGY TO NON ENGINEERS, FIRST RESULTS

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Minors in Engineering Studies: Teaching Technology to Non-Engineers, First results

Abstract

The Minor in Engineering Studies was designed by the college of engineering at our school to help increase technological literacy of the non-engineering students at our university. This program officially started in fall 2006 with little to no publicity. We have a program that started small and is now growing very little publicity by the college of engineering. In this paper we will discuss the challenges, and the success of the first complete year of offering this program at our college. The paper will discuss case studies of the type of students we originally attracted and the type of students that we think this program will best be suited. The paper will also describe some of the successful ideas and classes in our program. We show how the program could team up with different departments and strengthen the minor as well as expand the diversity of the subjects and classes that we can offer to our students. Finally we examine ways to offer successful classes by discussing some of the experiences our team gained during the last three terms.

Introduction

The need for better technological understanding and awareness of technological issues has been recently brought up to the forefront of engineering education circles. There are numerous managers, CEOs, policy makers, and leaders who are making critical decisions on technological issues related to technology and are not trained in the technical fields.

Technological literacy and public technological awareness have been gradually becoming the most important items on national education agenda. It is generally accepted the nations that are more technologically capable would play a more active role in international market place and future production [1-5].

The future advancements and developments in the US is bound to be more in the hi-tech area with high technically trained workforce. Due to the labor prices, the manufacturing that is totally dependant on manual labor will be moving countries with lower labor cost. Consequently, the main part of the non-engineering US workforce (especially those who will not have engineering or technological trainings) will have to have fundamental understanding of technology, the usage of technology and issues related to technology.

In addition fundamental understanding of technology is becoming necessary for many managers, directors, CEOs, as well as policy makers. However, most such key decision makers do not have engineering degrees. At the same time such individuals are defining policies, company directions, and future planning for technologically related or technologically affected disciplines. For such individuals, a fundamental understanding of the basis and concepts of technology, engineering, and technological developments are essential [3,4]

The Program

The minor in engineering study at our school started with the main goal to address the need for training the non-engineering student to be able to work, collaborate, help, and manage the engineering force. If most of the CEOs, Policy makers, directors, and managers in this country do not have engineering education, it makes offer technological appreciation and training to them. We know that this group will be making vital decision on technological issue. Consequently, our school embarked on a task to offer a minor degree, which is being offered to all non-engineering students,

The Objectives

The major objective for the Minor in Engineering Studies (MES) is to provide a technological education to non-engineering students with various backgrounds. Based on the reactions by different departments as well as colleges we have been emphasizing certain aspect of the program and program objectives to clarify our goals. The emphasis has helped some students to find the program attractive.

Our emphasis is that this is not an engineering degree. It should be noted that this is not a “minor in engineering” but a “minor in engineering studies”. The students will not be trained as an engineers (and cannot compete for engineering jobs) but will acquire a conceptual understanding of what engineering, engineering design process, technology, and technology-related concepts are. This program is trying to build basic literacy in engineering, and the first goal is to provide students with conceptual framework and working perspective so they would appreciate engineering and technological issues.

Consequently students who would receive a minor in the program will be able to,

- Better understand the role of engineering in society and the interactions of engineering with their major field of study
- Perform simple calculations and estimations using the engineering method
- Make simple cost-benefit and risk-benefit analyses
- Appreciate the importance of the underlying assumptions used to produce the cost-benefit and risk-benefit analyses presented by engineers
- Make informed decisions about the desirability of engineering activities by weighing the benefits of those activities against their environmental risks
- Understand the interdependence of the economic, environmental, and sociological aspects of technological change
- Assess the validity and possible weaknesses in predictions of economic, environmental, and sociological consequences of technological change presented by others
- Attain a basic understanding of the engineering design process
- Achieve a survey-level understanding of why particular materials and processes are used to produce simple engineering devices and systems

- Understand the capabilities and limitations of basic manufacturing processes and engineering systems.

Who is it for? and who is in it?

The program is design to be an effective minor to supplement the student’s non-engineering degree programs. This proposed program is designed to help students who are not engineering majors but are interested in understanding “how things work”

- Are looking at directorship, management, technical marketing, sales, and related careers in an industry that continues to involve more technology
- Are possibly interested in public policy—decisions impacting government, education, industry, religious institutions, health care
- Are thinking about working in bioengineering areas but not on the technical side.

Consequently, students of mathematical sciences such as physics, chemistry, and mathematics can take a minor in engineering studies. Our young program is currently engaging a few science students. Generally speaking those who are in Mathematics, Physics, and Chemistry have historically found typical engineering courses much palatable than the courses designed for the minor studies. A student of such fields can take any engineering class and use it for the minor degree. However such students have not yet found the MES program very attractive. The only students who are interested are in the areas such as meteorology and technology science and education students. To-date the we have been attracting few science students, however, most of our students are from business and architecture and design college. At the same time we do have students from Journalism, Economics, forensic sciences also attracted to the program.

The program

Few courses have been designed for this program. Due to the demand of the students, as well as our understanding of students’ perspectives and interest, all of the MES courses are design with not pre-requisite classes. In general we do not assume that students in the program have any other background than high school degree. This has been communicated to the students and is one of the attractive points for the interested students. Our first set of classes followed this and received wonderful feedback from the students.

The program requires 21 credits for each student. There are three introductory classes (ES) courses: ES 260, Introduction to Engineering: From Thoughts to Things; ES 265, Survey of the Impacts of Engineering Activities; and ES 270, Survey of How Things Work. Each student should also take 6 credits (2 classes) in approve course list of junior and senior level classes. These classes are offered by different faculty and are all related to understanding technology, technological development, and social, ethical, and environmental aspects of technology. The rest of the credits to make at least 21 credits can be filled approved class list including 2nd, 3rd, 4th, and graduate level classes. Each engineering department is offering classes in their field for such requirements. Our experience shows that many classes throughout the campus have been design with very close intention.

Early observations

While many departments and areas do not seem to be interested in developing any additional classes for their faculty, there are some very interesting results. Some of the engineering classes such as sustainably design, solar energy class, electromagnetic for non electrical engineering students have found that by allowing MES student to take the classes and not have as restrict requirement on those students as the engineering ones (while they are in the same class) they do get very interesting results. While the engineering students are very analytically capable, the MES students are much better skilled in verbal and reading and writing skills. Our first attempts in these classes show very successful results. Which means the idea that the MES student would be able to work, communicate and team up with the engineers is valid.

In addition, in our ES260 (where there are no engineering students) the students from business, economics, architecture, and design colleges are interested to work with engineering students in their projects. This has been the most interesting and unexpected result of our implementation. Students in the minor program would like to work with engineering students, on engineering projects, and also would like to see some back of the envelope engineering calculation. The students show not only interest in the subject but also eagerness to work on some engineering project to get a better appreciation engineering. Based on what we are seeing and learning from the first round of our classes and the first group of our students, we are modifying the program and are expanding our reach and effectiveness.

Conclusions

The minor in engineering studies is designed, initiated, and implemented by the College of Engineering to offer business concept classes and provide technological literacy to non-engineering students. This program has started in Spring 2006, and will have the first graduate in Spring 2008. This is one of the early reports on this effort. We believe it had a greater scope and importance than just our college and university. We think all engineering collages need to think about way to educate the non engineers in key technological concepts. Based on the experience with the first group of students and our first classes we are modifying the program to improve our work and expand our scope of the program.

Bibliography

1. "The Fundamental Role of Science and Technology in International Development: An Imperative for the U.S. Agency for International Development," *Committee on Science and Technology in Foreign*, U.S. Agency for International Development (USAID) and National Research Council (NRC) report, 2003.
2. "Technological Literacy (editorial)," George Bugliarello *The Bridge*, National Academy of Engineering, Volume 28, Number 2 - Summer 1998.
3. Jones, R. C. ,Kumar, T "Technological literacy for non-engineers," *Frontiers in Education Conference*, 1991. Twenty-First Annual Conference. 'Engineering Education in a New World Order.' Proceedings. 21-24 Sept. 1991 Page(s):179 – 184.

4. Krupczak, J.J., Jr.; Ollis, D.; Pimmel, R.; Seals, R.; Pearson, G.; Fortenberry, N. "Panel - the technological literacy of undergraduates: identifying the research issues," *Frontiers in Education, 2005*. FIE '05. Proceedings 35th Annual Conference 19-22 Oct. 2005 Page(s):T3B - 1-2
5. Krupczak, J.J., Jr.; VanderStoep, S.; Wessman, L.; Makowski, N.; Otto, C.A.; Van Dyk, K.; "Work in progress - case study of a technological literacy and non-majors engineering course" *Frontiers in Education, 2005*.