Teaching Engineering Economy in Engineering Technology Program

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Abstract

Engineering Economy is one of the most, if not the most, valuable required course(s) offered in most undergraduate engineering and engineering technology programs. The course is very important because most topics covered in it are used everyday in our personal and professional lives. Unfortunately, the importance of this course is greatly undermined as some students' have difficulties with the course. This paper will present the approaches I have utilized in teaching engineering economy to engineering technology students in the past ten years.

What is Engineering Economy?

Engineering Economy, which is also commonly referred to as Engineering Economics or Engineering Economic Analysis by some, is a course classified by the Accreditation Board for Engineering and Technology (ABET) under their Convention Criteria as technical specialty.[4] It is a required course for most engineering technology programs. It deals with the financial aspects of investments to help engineers and managers make decisions that are beneficial to the stockholders.

Engineering Economy is offered in most undergraduate engineering and engineering technology specialties such as civil, chemical, construction, electrical, environmental, mechanical, industrial, etc. Generally, it is offered at the upper-division level which is an advantage because it enables the students to take advantage of life experiences and knowledge acquired from their earlier studies. According to Erick Kasner in his book, *Essentials of Engineering Economics*, "Excellence in technology and engineering must include economic analysis and evaluation of cost and benefits (profits). (Engineering Economy) provides the tool for analyzing available resources, energy, and labor and the value of the new venture to society. More and more firms are looking for technologists and engineers capable of supervising a project from its conception through its economic analysis and on to completion. Too many schools have permitted their technical students to enter the business world without a sound technical economics background (1976, vii)."[2]

Engineering Technology and Engineering Education: Their Differences

It is not the objective or purpose of this section to exhaustively present the differences between engineering technology and engineering education. Rather, we will minimally discuss some differences in the two programs with a view to setting the stage for the succeeding section.

It is a common knowledge that engineering technology and engineering education have different emphasis. According to the Engineering Technology Council, "Engineering Technology Education focuses primarily on the *applied* (emphasis added by the author) aspects of science and engineering …"[5] as opposed to the engineering education, which emphasize theoretical development of concepts and design. Engineering technology education utilizes practical examples from world of work and life roles.

Beside differences in educational foci of engineering technology and engineering programs, the students enrolled in the two programs possess different academic ability. While students who probably rank near the top of their secondary or high school graduation class and who are analytically astute populate most engineering programs, the engineering technology students, in general, may possess far less academic acuity. Also, in general, the engineering technology programs may be populated by students with considerable variance in academic and analytical abilities.

Another difference is that the two programs have different accrediting commissions under the aegis of the Accreditation Board for Engineering and Technology (ABET).

Teaching Engineering Economy in Engineering Technology Program

In general, engineering economy does not require rigorous mathematical background which is welcome news in engineering technology world. Most daily real-world engineering economy problems can be solved with knowledge of algebra. In spite of the simple mathematics knowledge requirement, students, in the word of a colleague, "sweat" (meaning they work long and hard, I suppose) in engineering economy course (Vajpayee 2001, v).[7] The reasons for the sweating, I imagine, are as varied as respondents. In general, some students find engineering economy hard because of the *time* and *interest rate* components. Can you imagine any course you may have taken where if you add, say $100 to another $100 the answer may or may not be $200? In engineering economy, the answer is $200 only when the $100s occurred at the *same* time period and/or the interest rate is *zero*. Fortunately, most students do understand the concepts, though slowly, as the semester progress.

The following approaches have been employed in teaching engineering economy at the undergraduate level in the engineering technology program.

1. No Lecture, No Homework

When it comes to assignments my modus operandi is not to assign problems from a chapter that has not been covered in class. Although it may be used by some colleagues, especially in the

engineering program, I have learned not to do so even though I personally think that it will encourage students to be better prepared and active participants in the class. Consequently, I lecture on a topic or topics prior to assigning homework problems.

However, students are required to read materials for the next class in advance of the class and they are given a very simple 10 minutes quiz on the assigned reading at the start of the class.

2. Practice Application not Derivation of Formulas

Given the practical emphasis of engineering technology education and, in general, the limited analytical prowess of students enrolled in the program, the engineering economy course is taught devoid of derivation of formulas. The temptation sometimes to derive formulas to illustrate the effect of simple and compound interests is resisted. Rather, illustrations are accomplished by solving real-world problems using values not variables.

3. Have Students Work in Teams

Students are required to do their assignments in teams of no more than three. Each member of the team is required to submit their work for grading. To encourage team work, groups exhibiting no or very low score variance among its members in graded home work problems are given bonus points at the end of the semester prior to the computation of the course grade.

4. Emphasize Logical Presentation of Problems

It is very disheartening that students either lack the ability or desire to logically present solutions to assigned problems. In general, they prefer to only write down the answer they obtained from their calculators without showing the steps they took to arrive at the answer. Although making the students to show all their solution steps, especially drawing cash flow diagrams and stating applicable equations, has proved to be very unpopular with them, presentation of complete solution steps is a gradable requirement. To emphasize logical presentation of work, students have been given problems, especially during the early part of the semester, where computation is not required. Rather, the students are asked to draw cash flow diagrams and state the formula they will use to solve the problem noting the applicable variables and values.

5. Use Contemporary Issues in Class

To stress the practical orientation of the course, applicable contemporary issues are discussed in class regularly. For example, consider the following article that was used during 2002 fall semester. It appeared in "*The Hartford Courant*" newspaper issue of Wednesday, September 28, 2002 (page B9):[1]

Informant Testifies About Loan Sharks

"NEW HAVEN — The federal trial of two alleged loan sharks who targeted Asian gamblers at the Foxwoods Resort Casino has begun with testimony from an

informant.
The loan-sharking ring demanded $100 interest every three days for each $1,000 it loaned, the informant testified Monday in U.S. District Court.

Kun Lin, a 31-year-old New Yorker recruited by the FBI to infiltrate the ring, testified that Xiao "Steven" Chen, of Flushing, N.Y., asked him to invest $100,000 in the operation.

Lin's testimony came during the start of what is expected to be a weeklong trial of Chen and Gong Chai Sun of San Francisco.

The two men allegedly ran the loan-sharking operation from January 1999 to December 2001.

They are charged with conspiring to collect extortionate loans. Both are also charged with attempting to collect an extortionate $10,000 loan made in July 1999 and hundreds of thousands in loans made beginning in January 1999.

Each of the three charges carries a maximum 20-year federal prison term and fines based on their profits. Assistant U.S. Attorneys Michael R. Sklaire and Steve Reynolds are prosecuting the case."

Copies of the newspaper article were distributed to the class and they were told to compute the nominal and effective interest rates Chen and Gong Chai Sun (lenders) were charging for a $1,000 loan. The students were flabbergasted that the lenders were charging interest of about 3.23% per day. The nominal and effective interest rates per year, assuming 365 days per year, were 1,178.22% and 10,866,750%, respectively. After performing the computations, it became obvious to the class why the lenders are being charged.

6. Emphasize Personal Finance Issues

Upon graduation, some students will look forward to buying new cars, residential houses, and investing for their kids' education and their retirement. These topics are generously covered during class discussions and demonstration of application of concepts even though some students may have difficulty comprehending the importance. It helps if the class is composed of working adult students who may be dealing with personal financial issues. Students do appreciate the emphasis placed on issues immediate to them since they now possess the computational know-how.

7. Require Engineering Economy Portfolio

In their book, *Engineering Economy,* 12th edition, Sullivan, Wicks, and Luxhoj stated that the purpose of portfolio "is to demonstrate and integrate knowledge of engineering economy beyond the required assignments and tests (2003, xv)."[6] The importance of portfolio cannot be overstated, in my opinion, and its development in most, if not all, courses taught in the

engineering and engineering technology programs worthy of consideration.

The contents of a portfolio may contain, but are not limited to, articles relevant to engineering economy field, solved problems beyond those assigned as homework, economic analyses of projects, term paper, and computer programs to solve economic problems. The articles may come from recent issues of newspapers or magazines that the students are required to read and prepare a typed, double-spaced one page summary of the main points every week. Regarding term paper, a perennial title is "*How to Become a Millionaire in 30 Years or Less*." The objective of this term paper is to enable the students apply the concepts they have learned in engineering economy to plan their retirement in no more than 30 years from the year of graduation from a baccalaureate program. Students are astonished as how one can become a millionaire with careful planning and help from time. The adult and employed students have appreciated the exercise as it has given them the opportunity to plan their future finances.

8. Practice Conciseness and Simplicity

In order not to overwhelm the students, we drive home conciseness and simplicity in our lectures to minimize, if not eliminate, "sweating" in the course. The compactness of presented materials does not compromise course content since according to Pareto's Law (also referred to as 80/20 Rule, Principle of Imbalance, Principle of Least Effort, or Pareto Principle; named after Vilfredo Pareto (1848-1923), an Italian economist and sociologist (Koch 1998, 6))[3], the minority (say 20%) of topics covered in a course may account for majority (say 80%) of the knowledge necessary for its successful application. We present the 20% materials that hopefully will give them 80% of the practical experience.

9. Maintain Flexible Course Syllabus

The merits of course syllabus are well known to the teaching profession. It is a road map of the class. Because of several assumptions used in its development, the syllabus is quickly changed to reflect variance of reality and assumptions such as spending more time on a topic than originally assumed. It is also imperative that we do not attempt to cover all the topics listed on the syllabus, if it is not practical. The section not covered in class could be assigned to the students to read and summarize the main points or solve some problems for extra credit.

10. Provide Reference Books

Frankly, I have not been completely satisfied with many engineering economy textbooks. Generally, most authors cover too many materials, most of which are academic and rarely used in real world. Consequently, the engineering economy course syllabus contains a list of most, if not all, of engineering economy textbooks known to me for students' reference. All the books on the list are available in the school library.

Although there is a required textbook that the students purchase in the course for class use, they are also required to make use of the reference textbooks in the school library for expanded coverage, especially on practical topics not covered by the class textbook.

Conclusion

The foregoing strategies have been used, not necessarily in whole, while teaching engineering economy. The objective is to arm the students with the essential concepts and the applications of engineering economy so that they will bring to bear in their professional careers as engineers and/or managers.

References:

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