Work In Progress - Stratifying the Introduction to Engineering Design Course

Kenneth S. Manning, PhD
Adirondack Community College, manningk@sunyacc.edu

Abstract - The Introduction to Engineering Design (IED) course must be a down-to-earth, meaningful and engaging encounter for the students, must meet the academic needs of the program, and must be manageable and affordable, all within a three or four credit hour framework. Commonly, this course is taken once in either the freshman or sophomore year. We are in the planning stages to split the IED course over our two-years, rather than keeping it in its current single-year form. The current IED will be combined with an existing one-hour Freshman Seminar (FS) course, required of freshman and meant to expose new students to college life in general, and to the engineering educational requirements. This FS course will be expanded to overlap some of the work done in the more-involved IED, allowing both our first- and second-year students to work together in each of their two years. The FS course will continue to introduce freshman to college, but will also have them work on current projects with sophomore students in IED as part of the design teams. Each project will have a layered team of the more experienced 2nd year students working with the newer 1st year students, more reflective of the situation in industry. Time in the 2nd year will be spent without the freshmen from FS, to allow a more in-depth look at engineering management, ethics, and economics for the sophomores.

INDEX TERMS – Design Experience, First Year, Introduction to Engineering Design, Second Year.

INTRODUCTION

Nationwide, considerable time, money, and effort have been put toward the Introduction to Engineering Design (IED) course, which for so many students is their first exposure to the profession. Engineering educators strive to make this experience meaningful and engaging. If it is not the students will be lost to other majors; as many as half of the students entering do not graduate as engineers [1], [2]. Typically, this course is taken in the first or second year, often in the first semester of the first year.

At ACC this course is an elective credit, shared with the Engineering Technology Department. This means there can be freshmen enrolling in IED with limited math and physics backgrounds. Enrollment in a typical semester can have students with no practical experience working with professional machinists trying to upgrade their education, students in Differential Equations and Physics III working with students in pre-trig math and General Science.

Our IED course has been run in the spring semester, is three credit hours, and has either an Engineering or an Engineering Technology professor. Since we have no on-site manufacturing facilities and a total budget of $500, the course was run in a fashion too common in many other smaller engineering programs. The students were given an arbitrary task to accomplish (e.g. to ferry pennies up an incline), a semi-arbitrary box of parts (e.g. two old CDs, a mouse trap, and model car wheels), and were broken into teams to use those parts to accomplish that task in competition against the other teams in the class.

This approach to IED was artificial and only vaguely approximated a real engineering design atmosphere. The projects were trivial and in the short run produced only toy cars, and in the end left only parts cannibalized for next year’s course. The competition between the design teams was capricious and the teams were generally of one category of student in that all were brand new to this class. This did not duplicate in any way the real environment of engineering design. It ignores collegiality and cooperation on a larger scale, does not produce anything that contributes to the greater good (such as for a company or for society), and has no carry-over as the students themselves progress through their studies.

The vast majority of our graduates are going to spend their professional careers as good solid performers, a few moving onto management. Engineering management as a course topic is often ignored in the IED coursework.

This paper explains one novel idea we are developing to help us specifically address the problem of having students of very different backgrounds and academic levels in the same design class. Other schools are also trying creative configurations of the IED sequence [3], but we have not found concrete evidence that our particular idea is not original.

THE STRATIFICATION

Entering ACC freshmen of any major are required to take a survey course called Freshman Seminar (FS) to introduce them to some of the basics of the college experience, and to options after transfer. We discuss the campus in general, the Library, calculating GPA, and preparing for transfer, among other things. We typically conclude this one credit hour course with more targeted career information. This course is usually taken in the fall semester upon entering the college.

We have a special section of this course intended for the engineering majors that will specifically spend some time
looking at what is expected after transfer, graduate school options, and professional licensure.

Currently, at the students’ discretion, they may take IED in the following spring term, the spring of their next year, or not at all, electing to take it at their transfer school. Since we often have first- and second-year students combined we tried to model, at least in some measure, the real-life situation of new, young engineers coming into a firm and working with more sophisticated, more senior engineers. This was our first attempt at stratifying the IED experience. We also choose less arbitrary, more realistic projects, but that is the subject of another discussion some other time.

To take the stratification further we are now planning to restructure the course to require students to take part of it in spring of each of their two years to receive full transfer credit for IED (see Table I). We plan to have incoming freshmen engineering students take a two credit hour course that is one contact hour of career and college, with two contact hours spent with the second year students working on the design projects. In their second year they will spend two contact hours with their design teams- including the freshmen- and one contact hour on management issues.

The proposed changes to IED will accomplish several things that we see as crucial to the design experience. First, it models in a limited way the situation most of them will find when they join a real firm. They will come in as entry-level engineers, and immediately join projects already underway, with teams of other engineers who have been with the firm for some greater length of time.

Secondly, this allows us to work on longer range projects, which might cover several years, and keeps the students on those projects for a longer time. This adds continuity to both the projects and to the students’ experiences.

Thirdly, we can also focus to some extent on what is expected by and of engineering managers. This will make them better when managed, and will give them an edge when moving toward management themselves.

If a student takes the first year without the second they will receive that academic credit but will not get transfer credit for IED at their transfer school.

The changes to the current first year FS course are major enough that it is being replaced with the new 1st year course, named Engineering Career Exploration. This requires of us the writing, submittal, and acceptance of a new course proposal through the State University of New York (SUNY) system. This effort is underway with the hope that the proposal can be presented to the Committee on Academic Affairs here at ACC before the end of Fall term 2008.

The second year of the sequence, Engineering Design & Management, will only require modifications to the existing course, but will still necessitate passage through the ACC Academic Affairs Committee, and will not have to go through the SUNY system for approval. Neither course will go forward if either one is stopped or stalled in Academic Affairs- they require each other.

Since passage through the SUNY system can take quite some time we do not expect this course to be ready for enrollment until the Spring of 2009.

The current model of the Introduction to Engineering Design course is often that of either a trivial and arbitrary robotic competition, or a pie-in-the-sky attempt to find the next great entrepreneur. We are making it much more realistic, both in scope and in structure, and geared to meet the needs of the vast majority of the engineering students we meet: those who will go on to be solid performers in the ranks of the industry.

REFERENCES

