Curriculum Restructuring for Freshman Retention in the 1990s and Beyond

James R. Etchison
Electronics Engineering Technology Department
Oregon Institute of Technology
Klamath Falls, Oregon 97601

Abstract - *In 1994-95, freshmen in the Electronics Engineering Technology (EET) program at Oregon Institute of Technology began enrolling in a curriculum which had been restructured to improve student retention. During the first two years in which the new curriculum was in place, the number of students completing EET freshman courses and a sophomore semiconductor devices course with a "C" or better grade increased from 68% to 81%. This paper describes how OIT's freshman EET curriculum was modified, and encourages others to "stay the course" in terms of academic rigor in their programs, but to consider curriculum restructuring as a way to improve student retention.*

Introduction

Freshman retention has always been a source of concern for technical college educators, even during the enrollment boom years of the 1980s. But when enrollment in engineering and technology programs began to wane near the end of that decade, efforts to improve student retention took on a new sense of urgency nearly equal to that assigned to student recruiting efforts. By the 1990s, no technical institutions appeared to be exempt from this situation. At Oregon Institute of Technology, for example, even though the employment market for graduates was strong and growing, our enrollment was in decline. The need to recruit new students into the technologies was obvious, but the need to *retain* more of the students once they arrived on campus became equally clear after examining student attrition, especially during the first year of college.

This paper describes the OIT Electronics Engineering Technology (EET) department's successful approach to improving freshman retention, in the hope that others might profit from our experience. The paragraphs which follow will define the problem as we perceived it prior to our most recent major curriculum revision, discuss solution alternatives, the selected course of action, and the results.

Defining the Problem

In the early 1990s, faculty in the EET department at Oregon Institute of Technology began work on a major curriculum revision for the Bachelor of Science and Associate of Engineering EET degree programs. One of the many goals of the revision was to improve student retention, particularly at the freshman level, where only 68% of the students were completing EET courses with a required "C" or better grade. After considerable discussion and some hand wringing about the state of education and student motivation in the United States in general, EET faculty focused their attention on two things they could control: (1) the rate at which freshman were asked to adjust to the rigors of college life, and (2) the timing of electronics course work relative to the corequisite mathematics course work required by our program. Under the curriculum at the time, EET freshmen were required to take (by conventional standards) 17 to 19 credit hours per quarter of all solid material, with the exception of one 3 credit hour social science elective. New students that met the math requirements were immediately placed in a 5-day-per-week, 1-hour electronics lecture, and a 2-day-per-week, 3-hour electronics laboratory. Although the EET program had used this basic curriculum structure for decades, it was becoming clear that the erosion of academic standards in the secondary education system was taking its toll on the freshmen's ability to function adequately in an environment where grades were based on demonstrated ability rather than effort, seat time, or extra credit assignments.

At OIT, merely introducing a student to a topic is considered inadequate. We cover topics thoroughly, and expect mastery of the topic by the student in return. This educational philosophy dictates that students follow the rule of thumb of two hours of homework outside of class for every hour in lecture, plus plenty of hands-on reinforcement in the laboratory. Employers value our graduates because they not only know about electronics, they can do the work. Unfortunately, an increasing number of students entering OIT in the late '80s anticipated that academic requirements at OIT would be similar to those of their high school. By the time some of them realized that college was not going to be like high school, it was too late. The "problem" was that we expected the students to (in the words of their prospective employers) "hit the ground running" by doing at least three hours of lecture-related electronics work every day, plus their laboratory and other class work. The expected commitment to their educational pursuits was so foreign to some students that they could not or would not produce on a consistent basis.

The second problem related to mathematics preparation. College algebra is the minimum corequisite to begin our program. Although there have always been a few students placed in remedial math, by the 1990s their numbers were growing. At the same time, the mathematics department had to concede that even with students who placed into college algebra or higher upon entry, the professors were unable to cover material at the pace they once did. Math topics that used to be taught just in time for their application in the student's electronics class were in some instances being presented too late. We needed a solution to this problem as well as the first.

Solution Alternatives

In deed, there were some variations on themes for solving our retention difficulties, but basically

we were faced with two choices. We could follow the lead of an alarming number of secondary education systems by "dumbing down" our curriculum, or we could redistribute the curriculum to "soften" the transition from high school to college, and slightly delay the presentation of material requiring knowledge of determinants, trigonometry, and calculus. A few individuals outside the department would have been satisfied with a less rigorous, less in-depth EET program, but the first alternative was unacceptable to everyone in the EET department. We felt we could pursue the second alternative and enhance freshman retention without reducing the overall amount or quality of instruction in the program.

Course of Action

The 1994 EET curriculum revision was comprehensive. It resulted in a 200 credit hour bachelor of science degree program with four senior project options, and a separate 95 credit hour associate of engineering degree program. The revision impacted OIT's Laser Optics, Computer Hardware, and Electronics Engineering Technology programs, and the EET program at Portland Community College, with whom we have a cooperative curriculum agreement that allows PCC's EET graduates to enter our bachelor's program as juniors at either the Klamath Falls or Portland Metro OIT campuses. Only the curriculum modifications pertinent to freshman retention are discussed below.

Under the new curriculum, the first lecture/lab course sequence covers the electronics fundamentals and DC circuits material from the first six weeks of the old 5 credit hour course, stopping just short of network theorems. The 3 credit hour lecture meets on Monday, Wednesday, and Friday, instead of daily, so there is ample time for students to work on problems and seek help between class sessions. The accompanying lab is 1 credit hour instead of 2, so the credit hour / contact hour load in the first term has been reduced from 17 and 21 hours, respectively, to 14 and 16 hours. The lighter load in the first term is designed to give the student time to get situated in new living conditions, adjust to the rigors of college, and prepare for a more strenuous course load in subsequent terms. Delaying coverage of network theorems until the second term also guarantees that all students will have covered determinants in their math class before they are required to use them in electronics class.

With the exception of the topics covered in the EET lecture/lab sequence, the student's second term is the same under the new curriculum as under the old. However, now we ensure that the students understand from the outset that the first term was designed to give them a chance to get acclimated, and that during the rest of their program we are going to get serious about what we are doing. They are reminded to keep up with their daily lecture and twice-weekly lab assignments in order to survive the remainder of the freshman year. Topics in the second electronics course include network theorems, capacitance, magnetism, inductance, transient analysis, sinusoidal waveforms, average and effective values, AC response of R, L, and C elements, average power and power factor, and phasors. The students are guaranteed to be through the corequisite material in trigonometry before it is needed in their second EET lecture/lab sequence.

In the third term, EET majors study the following topics: AC circuit analysis, network theorems

applied to AC circuits, dependent sources, AC power and maximum power transfer, series and parallel resonance, passive filters, transfer functions, frequency response and Bode plots, and transformers. The third term credit hour / contact hour load is now 17 and 21 hours, respectively, compared to 19 and 25 hours under the old curriculum.

At the completion of third term, current students have covered every topic, at the same level of rigor, as students in the old freshman curriculum, except one: semiconductor devices. Moving this course to the sophomore year not only lightened up the freshman course load, it provided a better interface between the semiconductor devices course and the analog devices and circuits course which followed. (For those wondering what happened to the course work that had to be removed from the sophomore year to accommodate the semiconductor course, it has been fortified and is now presented in the senior year as part of a power amplifiers and selected topics course.)

Results

Freshmen began enrolling in the new curriculum in 1994-95. During the first two years in which the new curriculum was in place, the improvement in student retention was even better than we "true believers" in our course of action had predicted. The number of students completing EET freshman courses and the sophomore semiconductor devices course (previously a freshman course) with a "C" or better grade increased from 68% to 81%. Now, after three full years under the new curriculum, with scores of sections having been taught by eight different instructors, we are still at a respectable 79% average retention rate for the courses being monitored. Interestingly, what appears to be a sustainable long term improvement in student retention occurred without any fanfare, and no one was encouraged to relax academic standards in any way to achieve the gain.

Conclusion

The results of the curriculum modifications initiated by the OIT EET department in 1994 prove that curriculum restructuring for freshman retention can be effective. Furthermore, freshman retention can be improved without succumbing to the temptation to reduce program rigor. Engineering and technology curriculums can "stay the course" in terms of academic rigor, and still reduce attrition through careful curriculum design geared to the students of the 1990s.

References

1. OIT EET course enrollment data for 1986 through 1994 (printed rosters and grade records).
2. OIT *Banner System* "mass drop" electronic records for 1994 through 1997 EET courses.
3. Oregon Institute of Technology General Catalogs for 1993-94, 1994-95, and 1996-97.
4. Boylestad, Robert L., "Introductory Circuit Analysis" 8th ed., Prentice-Hall, 1997.

Biography

JAMES ETCHISON began teaching for Oregon Institute of Technology in 1986, following sixteen years of industrial experience. He served as the EET Curriculum Coordinator from 1993 to 1997, during which time the curriculum modifications discussed in this paper were developed. Professor Etchison is currently Chair of the Electronics Engineering Technology Department at OIT.