Innovative Curriculum Modifications to Improve Retention in Electrical and Computer Engineering Technology Degree Programs

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Abstract

Southern Polytechnic State University possesses three Bachelors of Science undergraduate degree programs in the ECET department: Electrical Engineering Technology (EET), Computer Engineering Technology (CpET), and Telecommunications Engineering Technology (TCET). These Engineering Technology degree programs have evolved over time via a process of continuous improvement in keeping with ABET accreditation standards. In the Fall of 2005, significant curriculum changes were approved and instituted among all 3 programs which had not occurred since 1998. Both internal examination and external pressures, such as an ever changing technological base and the swift employment marketplace, continue to influence the modification of the curriculum in several innovative ways including: structural changes (prerequisites and elective vs. requisite course balance), chosen electives, capstone course evolution, etc. Numerous foundational courses are common to all three majors and are offered early in each program, primarily in the first and second years. However, one key course (ECET1011 - Fundamentals) was identified for particular attention with efforts to improve both retention and student overall preparedness in ECET.

Originally, this Fundamentals course was 1-3-2 meaning that there was one hour per week of lecture, 3 hours of laboratory, and 2 hours of course credit. Over time it was determined that students were simply not getting enough instructor interaction. Thus, inspiration to place a high emphasis on this critical course which chiefly introduced DC circuits among other introductory concepts for future ECET coursework was woefully lacking by most students. Also anticipated from this course was to clearly identify for the student what their chosen major is all about, with hopes that they are thoroughly energized and want to immerse themselves in all of its challenging aspects. An experiment of offering this course with lecture consisting of 2 days per week for 25 minutes each day proved fruitful, although more class time was necessary to accomplish the goals and the objectives of the course. By cleverly maneuvering elective hours, it was concluded in 2005 that this Fundamentals course should be changed to 2-3-3 so that a full 50 minutes, twice a week could be realized. This paper seeks to determine the successes and failures of this course’s recent changes, its impact on student retention, as well as all other subsequent ramifications to ECET students and the ECET curriculum.

Introduction

In the fall term of 1998, Southern Polytechnic endured a total culture change (if not shock) when we were mandated by our governing Board of Regents to transition from a 10 week quarter based curriculum to 15 week semesters. This conversion was taxing to say the least, as many classes had to be compressed and combined in order to cover all the appropriate material. Under the quarter system, there was much more flexibility in offering a wider range of courses as seen in a typical EET curriculum flowchart on the next page. Debates among the faculty ranged from focusing on the basic principles to incorporating the latest state of the art technologies in the classroom. A compromise decision was made where all 3 undergraduate majors (Electrical, Computer, and Telecommunications) would share a common core of classes in the first 2 years of the curriculum and then branch out in the final 2 years to include material that is more particular to the current trends of the associated major along with sufficient technical electives. All three curriculum flowcharts reflect this ideology. Both theoretical and practical aspects were combined to equip the student with a complete set of skills and knowledge required to compete in the industrial marketplace. In this manner, the ECET tradition at SPSU of hands-on learning by doing with virtually all classes having an incorporated lab component was maintained.

The Motivation, Means and Mechanics

Key to the successful transition to semesters and the goal of balancing the basics with up and coming technologies was to introduce a new course that did not exist in the quarter curriculum entitled Fundamentals, ECET 1010. The intent of this course was to highlight aspects of each of the three majors, both their origins and applications, so as to maintain the interest
of freshmen students by thoroughly informing and preparing them for their choice of major with earlier exposure so that they might feel engaged in their discipline sooner. Unfortunately, the ECET 1010 course was only granted one hour per week of lecture time along with a three hour weekly lab. As the course evolved there was too much emphasis placed on circuits alone, while not giving any time to computer or telecommunications topics. Many joked that the course had practically turned into Circuits one-half! Subsequently, many students found the course boring and not at all fun or engaging. In fact, some of the labs that were developed to ensure that all majors were emphasized were either tossed aside or covered in passing. The remaining core of ECET classes are summarized below:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECET 1000</td>
<td>Orientation</td>
<td>2</td>
</tr>
<tr>
<td>ECET 1010</td>
<td>Fundamentals</td>
<td>1</td>
</tr>
<tr>
<td>ECET 1100</td>
<td>Circuits I</td>
<td>4</td>
</tr>
<tr>
<td>ECET 1200</td>
<td>Digital I</td>
<td>4</td>
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<tr>
<td>ECET 2110</td>
<td>Circuits II</td>
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<td>ECET 2210</td>
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<td>ECET 2300</td>
<td>Electronics I</td>
<td>4</td>
</tr>
<tr>
<td>ECET 2310</td>
<td>Electronics II</td>
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Although across the country engineering and engineering technology programs have been experiencing declines in enrollment, the ECET department at SPSU has consistently had proportionally large programs on campus. As seen in Table 1 below, all three ECET undergraduate majors have suffered in enrollment and retention ever since our quarter to semester conversion.

Table 1: (This data is being confirmed by our IRPA dept and will be included in the final paper)
Attempts at Solutions

In the academic year of 2005, we sought to address this problem while also addressing the new accreditation standards of ABET. Upon close consultation with our Industrial Advisory Board (IAB), the ECET department began to implement the arduous process of reinvigorating our curriculum. In fact, the IAB was a tremendous resource in addressing what needed to be done. For example, although the faculty consensus had found the engineering graphics course (EG1210) to be minimally helpful, and we had plans to remove it, the IAB convinced us to keep it. Even though the reorganizing of the curriculum was an arduous process, there were thankfully much less changes than back in 1998 for the semester conversion as can be easily seen when comparing Figure 1 (above) to Figure 2 below. For the most part, our curriculum was very strong; however, minor tweaks were needed to improve the quality of our programs. Maintaining strong and rigorous academic programs was paramount to our concern. Central to the change was to reexamine the Fundamentals course (ECET1010) in addition to modifying the upper level courses, such as including a specific senior capstone design course. After going through bureaucratic channels, we successfully added an additional lecture hour per week to the course and renumbered it as ECET 1011 (2-3-3). Not only did this allow for more time in covering the circuits topics, but supplied ample opportunities to expand the coverage and include digital and telecommunications material. In addition, the laboratory exercises were analyzed and redesigned such that the course content matched more closely with the lab. Further, hands-on interactive lab exercises involving soldering both an FM transmitter circuit and the complete construction of a reliable Digital multi-meter for future course use was employed. Not only did this put the “Fun” into Fundamentals, but the “mental” portion of the course that students often find so difficult became more natural.

![Figure 2: 2005-2006 EET Flowchart reflecting changes for 2005](image)

Varied Course Offerings

Starting in the Fall of 2005, ECET 1011 was offered in both day and evening formats with large and small class sizes. Three different faculty taught the lecture section of the course and associated labs along with 2 other faculty members assisting with the numerous lab sections. Additionally, graduate students assistants were trained from our MSET program to assist the faculty members during lab so that students would have even more one on one interaction. As anticipated, class sizes any larger than 40 were detrimental in the student learning even with vibrant and energetic faculty. The extra lecture hour per week proved, as expected, to be substantially better both for the students and the faculty who were not rushed to complete the
A vast amount of material on the syllabus. Further, being able to see the students’ faces twice a week was a significant improvement allowing for a much better rapport and relationship development between both student to student and student to instructor. The course material at its very nature is challenging, so there was unfortunate attrition up to and during the drop week. However, for the most part there was an increased interest among students in this complex subject matter with a much more thorough preparation for the future courses. Only time will tell over the next several years, but the early reports from faculty of subsequent courses, such as Circuits I and Digital I, indicate that the new 1011 Fundamentals is doing a fine job.

The course continued in both day and night offerings for Spring 2006 and Summer 2006, but with a few minor modifications. Emphasize and enhance what worked… Revamp what did not!

In an attempt to match freshmen students to upperclassmen who could possibly tutor and give guidance was attempted in the Fall semester by assigning one senior to 2 or 3 freshmen. Senior ECET mentors was a neat idea, but the vast majority of students did not meet with each other at all. We plan to try out “learning communities” in the future to attain similar goals, but currently we are not formally making such mentoring assignments any longer. Occasionally, a senior student who wants to “give back” will assist in lab which is always a treat for both instructor and students!

In general, the students savored the hands-on construction of the FM transmitter during one 3 hour lab session to introduce soldering skills. An inclusion of a microphone for a “wow factor” so that students could speak into their FM transmitter and hear it to jam a nearby radio, perhaps inside a moving automobile, was even better. The students also were even more energized with the multi-week task of soldering a multi-meter towards the end of the term. Both of these kits are highlighted on our ECET website along with all associated labs. With the additional hour per week granted to the course, there was plenty of time to discuss how various parts of the multi-meter functioned (such as the LCD or the transistor) without going into too much detail that would require knowledge of future courses. In the Spring of 2006, we had significantly better functionality results from students as the result of transitioning from the Elenco 51001 kit to 1006K multi-meter kit. Each kit is virtually the same, except the 1006K has a pre-soldered, surface mounted microcontroller; plus the PCB is tested afterwards. Some students in the fall term were frustrated upon receiving a PCB with a crack or open trace causing hours of debug time. Regardless, the student surveys consistently indicated that building these learning tools were an invaluable help in understanding and mastering the course objectives. Students were able to visualize how voltage, current, resistance, etc. all interact and work together in a complete circuit application. Pictures of the kits can be found online at chipsanddips.net.

Conclusion

Although surveys have been done and we have some testing results, we need to develop more standardized objective assessment tests or determine some other means of formative evaluation to truly determine how well ECET1011 is succeeding in improving retention. It is certainly not our desire to test the students yet again, but in order to get some more accurate feedback we may (perhaps, and unfortunately) resort to this traditional means unless we can determine a viable alternate. Evaluating grades in Circuits I and Digital I and comparing them to the past results, as well as subjective positive and anecdotal remarks by faculty and students have all shown that the new version of Fundamentals is better than its past counterpart. No major changes are envisioned to the ECET1011 course for the upcoming academic year. However, the addition of a section on telecommunications basics to the course has been discussed and is planned for implementing in this next academic year. Further, we will always place a high emphasis on reevaluating the effectiveness of this course, giving it a special attention in our continuous improvement process since it is at the very cornerstone of our ECET curriculum.

References

[1] URL: http://ecet.spsu.edu/home/Planning/Planning-EET.php
[2] URL: http://ecet.spsu.edu/home/Programs/Programs.php