Transitioning from Engineering Technology to Engineering: Relocating Critical Material

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Abstract

The University of Southern Indiana is transitioning from Engineering Technology to Engineering. For twenty-seven years, USI has taught engineering technology, currently supporting Bachelor's degrees in Electrical Engineering Technology, Civil Engineering Technology, and Mechanical Engineering Technology. These three programs will be replaced by a single degree, the Bachelor of Science in Engineering.

Incoming freshmen for the fall 2002 semester were admitted into the engineering program, while transfer students only were accepted into the engineering technology program. The first two years of the new engineering program are in place, while almost the entire engineering technology program is still operating. In spring 2003, no students, including transfer students, will be admitted to engineering technology, and the first three years of the engineering program will be populated with students.

Many issues must be explored when a school changes program curricula, such as which classes to update and transition versus classes to delete; pre-requisites and co-requisites; class sequences; laboratory sessions; classroom assignments; faculty loading; and many more.

The Accreditation Board for Engineering and Technology, Inc (ABET) criteria [1] point to distributed emphasis on the "soft skills", such as technical writing, public speaking, and working on teams, while maintaining student performance in the technical areas.

Two of the author's classes, which were originally developed to enhance student performance during the Capstone course, were scheduled for deletion. However, the experience level needed to be maintained, so this material needed to be absorbed into other courses while maintaining course and program dynamics.

This paper explores the issue of relocating critical material from deleted classes into classes that are transitioning into the new program.

Background

The University of Southern Indiana is transitioning from Engineering Technology (ET) to Engineering. For twenty-seven years, USI has taught engineering technology, currently supporting Bachelor's degrees in Electrical Engineering Technology, Civil Engineering Technology, and Mechanical Engineering Technology. These three programs will be replaced by a single degree, the Bachelor of Science in Engineering (BSE).

Many area businesses and industries had engineering jobs that needed to be filled. They were having difficulty recruiting and retaining engineers into these positions and felt that an engineering program at a state-supported school would help fill that need. They looked to USI to help fill their need, and studies were conducted to investigate both the need and possible solutions.

In Indiana, ET graduates *could* be licensed as Registered Professional Engineers (PEs) with some additional preparation, mainly an additional Calculus class and calculus-based Physics classes. However, surrounding states would not recognize these PEs, thus causing PEs holding an ET degree to be less valuable than a PE holding an engineering degree, even though both had passed the same rigid examinations.

When the author arrived at USI in the fall of 1999, there were 10 faculty for the entire ET program, and the ET program was undergoing an ABET visit. Of these 10 faculty, 6 were planning to retire within 6 years. The concern here was that:
- At least 60% of the faculty would not be here when ABET visits again
- With that large of faculty turnover, the program will change immensely
- If the USI program is going to change that much, why not change to Engineering?

Two independent consultants with extensive ABET experience were commissioned to determine if the USI ET program could be strengthened into an engineering program. Receiving positive responses, the faculty conducted a needs assessment with local business and industry. A Bachelor of Science in Engineering (BSE) degree was chosen, with classes in Mechanical Engineering, Civil Engineering, and Electrical Engineering. The BSE could incorporate the current electrical, civil, and mechanical ET programs, with plans to add manufacturing engineering courses later. Local business and industry hailed the decision, as did local political leaders. The Indiana Commission of Higher Education, however, turned the USI proposal down in September 2001. After some political wrangling, the USI proposal was granted in May 2002.

With such a small faculty only one program could be supported, so the ET program was scheduled for termination. Current ET students were notified of our intentions, and advised of their options:
1. Change to Engineering, and repeat some technical coursework
2. Remain in ET…with a scheduled closeout date of Fall 2006

Incoming freshmen for the fall 2002 semester were admitted into the BSE program only, while transfer students only were accepted into the ET program, and that completes **any** admissions into ET. Many students had arrived in fall 2001 wanting the Engineering program, and were advised to concentrate on satisfying University core curriculum (English, Calculus, Chemistry, Physics, etc) and *hope* that the Engineering program would be approved soon. When the Engineering program actually began in fall 2002, there were twice as many students for freshman engineering classes, with several sophomores ready to populate some classes.

The first two years of the new engineering program are now in place, while there are sophomores, juniors, and seniors in the ET program. In fall 2003 the first three years of the engineering program will be populated with students, with only juniors and seniors in the ET program.

Changing programs

Many issues must be explored when a school changes program curricula, such as which classes are to be updated and transitioned and which classes are to be deleted; which classes are pre-requisites and co-requisites; class sequences; laboratory sessions; classroom assignments; faculty loading; and many more.

The Accreditation Board for Engineering and Technology, Inc (ABET) criteria [1] point to distributed emphasis on the "soft skills", such as technical writing, public speaking, and working on teams, all while maintaining student performance in the technical areas.

Two of the author's classes in the Electrical Engineering Technology program, which were originally developed to enhance student performance during the Capstone course, were scheduled for deletion. However, the students' experience level needed to be maintained, so this material needed to be absorbed into other courses. It was determined that this material could be inserted into the engineering core courses, so that *all* students could benefit from it.

Pre-requisites and class sequences

Changing programs allowed the faculty to re-evaluate the sequence in which the students perform their coursework. This enabled us to ensure that basic concepts were learned first, and subsequent coursework built upon that. Logical progression of coursework would enhance student learning and would improve teaching by eliminating the need for remedial work in class. Thus, courses would flow – naturally progressing into higher knowledge in a more timely fashion.

More than a name change

Changing from ET to BSE involved much more than changing the prefix on courses and carrying on as before. Each class was examined first to determine if it was still needed. If the class was still needed, further study was conducted to:
- determine where it will best fit into the curricula,
- specify the appropriate pre-requisites and co-requisites,
- investigate ways to improve the course (including upgrading calculus content),
- determine the class goals and objectives,
- determine class pedagogy, and
- determine assessment requirements.

If, upon examination, a class was found unsuitable to be transitioned into the BSE program, it was examined for any content that should be retained. Two of the author's classes, *Electrical Project* and *Advanced Electronic Circuits*, fell into this category, and some of the content was still needed.

In *Electrical Project*, the class was conducted as a first coop work assignment. The students select and build an electrical or electronic project [2]. The students are required to construct a

project timeline using Microsoft Project, obtain all of the project components, submit weekly status reports on project milestones, design and etch a circuit board, write a preliminary and final technical report, and present an oral presentation using Microsoft PowerPoint.

The goals of this class were:

- to learn to construct a **Timeline** (Gantt chart) using *Microsoft Project*. This forces the student to assess the amount of work to be done and the amount of time available, and to reconcile the two around events (Super Bowl, March Madness, tests, etc)
- to learn to submit **Weekly Status Reports.** This forces the student to continually make progress because project status is updated weekly.
- to write **Technical Reports**. The Preliminary Report is the midterm exam and the Final Report is the final exam. The main emphasis of the Preliminary Report is to force the student to begin writing **before** midterm. The Final Report is an outgrowth of the Preliminary Report.
- to learn to design and build a **PowerPoint Presentation.** By learning to use PowerPoint as sophomores, when the students become seniors they may concentrate on their project rather than having to learn the presentation software.
- to practice giving technical presentations by requiring an **Oral Presentation** as a final requirement. This provides valuable experience on presenting a formal oral report, synchronizing with the PowerPoint presentation, and facing stagefright.
- To gain **Troubleshooting Skills**, which are best taught by experience. Troubleshooting *techniques* can be taught, but the skill itself must be an individual, spiritualistic, experience.
- to allow the student to learn project management by allowing them total control. There was **no homework or tests**, which allows the student to concentrate on the main goals of this class – the project functionality, the oral presentation using PowerPoint, and the technical reports. This is often referred to as *they are given enough rope to hang themselves*

This class was designed to be Step 1 to the Capstone course, *Senior Project*. The project management skills, interpersonal skills, and troubleshooting techniques which were taught in this class, and the two useful software packages that this class utilized, proved very useful during *Senior Project*.

Step 2 to the Capstone course, *Senior Project*, was *Advanced Electronic Circuits*. In *Advanced Electronic Circuits*, students split into teams. Each student served on two teams, with two different people – on one team the student was a leader, and on the other team, an assistant. Each team was assigned a project, with a written report and oral presentation using PowerPoint required. This course was designed to be taken during the last semester before *Senior Project*.

The goals of this class were:

- to refresh project management skills
- to refresh technical report writing skills
- refresh PowerPoint skills
- to give each student a true teamwork experience

- give each student a taste of managing a project and managing an assistant
- give each student a taste of being a subordinate on a project

Without these two classes, "soft skills" development would be hindered. The faculty agreed that these skills need to be developed, and sought to determine where these skills should be taught. The two software packages, Microsoft Project and Microsoft PowerPoint, were placed into the engineering core curriculum, specifically in the freshman design classes *Introduction to Design I* and *Introduction to Design II*.

ABET criteria point to distributed learning to develop the writing skills, to develop the ability to work on teams, and to hone presentation skills - meaning that these need to be taught in many classes throughout the curriculum rather than in just one class. For those students taking electives in the electrical engineering area, the teamwork skills shall be handled via laboratory experiments and projects in *Digital Logic, Discrete Electronic Devices, Integrated Circuits, Signals and Systems, and Electrical Power.* At least one formal report shall be required in the last 4 aforementioned classes, and a PowerPoint presentation shall be required in *Electrical Power.*

In conclusion

Program changes, such as the USI change from ET to BSE, are fraught with difficulties. Someone once said that an opportunity is a difficulty turned inside out. This transition has allowed USI engineering faculty to correct some problems that had developed over the years, such as course sequence problems. This change also "shook up" the curriculum - pruning the program enhances the experience for the student and allows program growth where technology had outpaced the coursework. Each class was examined for inclusion in the BSE program or deletion. Classes that transitioned were enhanced by incorporating calculus into the coursework as appropriate, as well as being materially updated. Deleted classes were dissected to ensure that relevant material remained in the curriculum.

While this process has been painful, it has been very exciting, too. ABET 2000 Criteria lead engineering faculties to examine their own curricula periodically to keep their material fresh and exciting, and to be proactive in seeking relevance with industry. USI was very fortunate to be able to implement these Criteria from the outset of the engineering program.

Bibliographic Information

[1] ABET (Accreditation Board for Engineering and Technology) Criteria for accrediting engineering programs.
[2] West, B. 2001 Innovative Student Projects at the University of Southern Indiana *Proceedings, 2001 Annual ASEE Conference*. American Society for Engineering Education

Biographical Information

Mr. Brian E. West is an assistant professor in the engineering department at the University of Southern Indiana. He is a registered professional engineer in Indiana, and has written several papers on his classroom activities.