AC 2008-1025: ADAPTING TRADITIONAL ELECTRICAL ENGINEERING COURSES FOR NON-TRADITIONAL STUDENTS

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Adapting Traditional Electrical Engineering Courses for Non-Traditional Students

Abstract

At the request of local industry, the University of Wisconsin-Platteville recently started remote electrical engineering collaborative programs at two of the University of Wisconsin System's two-year schools. These programs were specifically developed to allow place-bound nontraditional students, who work during the day, to obtain their entire under-graduate electrical engineering degree on a part-time basis without having to travel to the main campus located 90 miles and 180 miles away respectively. Students in the program typically take two engineering courses per semester from the on-site faculty supplemented by distance course offerings as needed. Each of these courses has the same content as the ones offered at the main campus, including laboratory work and semester design projects. Courses in Math, Science, English, and the Humanities are offered by the local two-year school. The specific needs of our non-traditional students and the ways the course offerings at our site have been adapted to meet those needs are discussed. The unique challenges of this type of program are also discussed.

Introduction

One of the main objectives of the College of Engineering, Mathematics, and Science at the University of Wisconsin-Platteville (UW-Platteville) is to ensure that its students gain the knowledge and develop the mental skills and personal characteristics necessary to become successful citizens and professionals who can meet the present needs of industry. In recent years, companies within our state have found it much harder to meet their engineering needs. They have unsuccessfully tried to meet these engineering needs with graduates from other regions of the country, only to find that these engineers, without any ties to this region, leave after a few years. At the request of the local industry, collaborative electrical engineering (EE) programs were started in the fall of 2006 in the Fox Valley and in Rock County, both areas of the state that have a strong manufacturing presence. These programs are located at the University of Wisconsin-Fox Valley (UW-FV) and the University of Wisconsin-Rock County (UW-RC), which are two-year schools within the larger University of Wisconsin System. At each site, a small engineering building, consisting of a media classroom, a laboratory, offices, and a storage facility, was constructed and paid for by funds from local industry and private donations. As part of the collaborative agreement, prerequisite courses (math, science, english, humanities, etc.) are offered by the local two-year school, while all courses within the engineering major are offered by faculty from UW-Platteville, under their ABET accreditation. The creation of the EE collaborative program at UW-FV joined an established collaborative mechanical engineering (ME) begun in the fall of 2002[1], while the program at UW-RC was established from scratch.

The collaborative program concept, designed for working and place-bound adults, will allow students to complete their entire four-year engineering degree on a part-time basis at the local two-year university-system school without traveling to the main campus. Each of the courses offered via the collaborative program has the same content as the ones taught on the main campus. To get students into their major courses sooner, many of the beginning EE courses require "just-in-time" mathematics and physics. Course offerings are primarily in the evenings and on Saturdays as required.

Designing Course Offerings for Non-Traditional Students

In recent years, most universities have seen an increase in the number of non-traditional undergraduate students on campus. While at my previous position at a more traditional campus, I recognized that a significant number of my students were working and going to school. As a result I wrote and received a University of Wisconsin system grant to improve the learning of non-traditional students in the Analytical Methods of Engineering course that I taught. In this prior work[2], I utilized technology to make the course more accessible and efficient. In-class time savings were used to do more examples and to incorporate in class assessment techniques such as pair and share to determine the level of student understanding. I found that the changes that I made to help the non-traditional students in my class helped improve the class for all of my students.

Unlike at a traditional institution where non-traditional students are treated as an exception instead of the rule, in this new collaborative program non-traditional students are the majority and traditional students are the minority. As a result, the course design needs to be tailored to the needs of non-traditional students and the validity of basic pedagogical assumptions had to be evaluated. In pedagogy (child model), we typically assume that the students have little if any outside experience pertaining to the subject matter and therefore are dependent on the instructor[3]. In Andragogy[3,4,5] (adult model), we assume that the adult learner has high quality life experiences prior to setting foot into the classroom. This latter model may be a better model under certain circumstances. For example, the first class in the fall of 2006 at UW-RC was Circuit Modeling I. The class contained 9 students, whose average age was 30, including several technicians with many years of experience.

In redeveloping engineering courses for non-traditional students, I have found the following techniques to be helpful. First of all it is important to prioritize the material to be included in the course. To accomplish this, the entire course (lectures, exams, homework, etc.) should be objective driven[6]. If the material is not covered by an objective, it should not be in the course. This will help remove "busy work" and allows students to focus on the more important items. Second, give graded homework, 2-3 problems, during every class. This allows students to better understand the key concepts from each lecture and gives the instructor continuous feedback on misconceptions. I typically have homework due on the morning after the next class to provide a time for questions during the next class. By doing this I have found an improvement in the number of submitted homework assignments. Third, the use of technology is an essential part of addressing the needs of non-traditional students. Non-traditional students with the added responsibilities of work/family will miss some lectures during the semester. The course website is used in a manner similar to that for a distance education course, allowing students to stay up to

date with the class in the event they cannot attend. Course and exam objectives are posted as are important due dates. Office hours and contact information are provided for student use. All work to be submitted for grade (Homework, Projects, etc.) plus examples are posted. Homework solutions and practice problems with answers are provided as feedback. Lecture notes and readings are posted in advance to allow efficient coverage of the theory and more time for in-class examples and assessment. In-class "board-work" using the document camera is scanned and placed on the class webpage. Electronic submission of homework and projects is encouraged, allowing students to make fewer trips to campus. Fourth, flexibility should be incorporated into the course syllabus. Most non-traditional students have outside commitments such as work and family which require missing at least 1 class per semester. Allowing students to drop their worst exam, quiz, homework, etc., helps students overcome such absences. Finally, assessment needs to be an integral part of each course. Instructors need to determine the concepts that students are having trouble with prior to the examinations. In-Class Assessment techniques such as Pair and Share, Muddiest Point, one sentence summary, and ConcepTests can be used throughout the semester in addition to pretests and quizzes to determine the student's understanding of key concepts at various levels of learning (Bloom's Taxonomy). Results allow the instructor to focus on areas of need, adding additional examples on the website to address points of poor understanding.

Laboratories

The laboratories are one of the strengths of the UW-Platteville EE Program. Like the courses offered on main campus, all but one electrical engineering course has a laboratory and most have semester design projects. The laboratories are integrated together with the theory. The laboratory portion of the course helps those with prior lab experience, such as technicians, to better understand the theory of the class and provides valuable hands-on experience to those without prior experience. After students completed Circuit Modeling I, the lab time for future courses is not scheduled (open labs). This allows the student to complete his/her lab work at their convenience. Upon completion the student signs up for a lab "check-off" and completes a written report. This model assumes the student has achieved a certain level of maturity to work independently and complete the work in a timely manner. Both our non-traditional students and traditional students like the flexibility of our open labs.

Assessment

One of the most important portions of this new collaborative program is assessment. Not only is ongoing assessment important within each course, the entire program is undergoing continuous assessment. Although this new program was developed for place-bound students who work during the day and work toward a degree at night, in reality there has been a mixture of students with varying age, experiences, motivation, funding, and priorities. The current program consists of ~50% students who are fully employed and ~ 33% traditional-age students who are working part-time. Our initial cohort of 9 students (began fall of 2006) is down to 6 (one failed the first course, one person was transferred out of state, and another has taken a break from the program). The second cohort of 9 is down to 7 (one failed the first course and a second decided to go in another direction after successfully completing the first class). We have about 45 students currently in the EE program at UW-RC and another ~30 students in the EE program at UW-FV ,

but most of them are in the process of completing their prerequisite coursework at the two-year schools.

One of the assumptions of the program was that fully employed students could handle two four-credit courses including lab during a semester. This assumption was tested during the fall of 2007. It turned out that the workload was too heavy for some of those in full-time salaried positions with families. This caused some of the students to reevaluate their plan. As a result several of the students are planning to take 1 class each semester plus one in the summer instead of the planned two classes per semester in the fall and spring. This has also impacted our schedule of projected course offerings.

On the positive side, the mathematics issues which we thought might be a major stumbling block for those students who either took the prerequisite course long ago and forgotten it or for those who never really learned it in the first-place has not been as bad as we had envisioned. Through in-class reviews and review material/links on the webpage we have been able to help students meet most of the mathematical challenges to date.

Logistical Issues with Remote Education

A major draw to this program is the ability to complete the entire degree on a part-time basis at the remote site (2-year school) without having to travel to the main campus. A problem with this approach is that the remote sites only have limited faculty (initially 2 faculty members at UW-RC and 1 at UW-FV). The on-site faculty will not have expertise in every area. In addition, circumstances will occur where students will have to make-up a missed/failed course or wish to take a specialty course offered on the main campus. The initial thought was to offer these courses via distance education. The issue with our EE curriculum is that each course has a laboratory and most have design projects. This is a major strength of our program as indicated in our recent ABET evaluation and by our industrial advisory board.

The problem of how to deliver laboratories to remote locations has long been a stumbling block to the creation of distance electrical engineering programs. As a result, there are very few distance education programs that are totally offered remotely[7]. Some institutions try to by-pass this issue by requiring that their students spend an extended period of time on the main campus[8,9] (usually in the summer), which is not really an option for place-bound students. Others create virtual laboratories or simulations[7,10,11]. Unfortunately, virtual laboratories take a great deal of effort to create and are usual limited to lower level labs and the commercially available equipment that "facilitates" such usage is often quite limited (for example National Instrument's Educational Laboratory Virtual Instrumentation Suite (NI ELVIS) is very frequency limited). Although this may be an option for some introductory laboratories in a few of the core classes, these options do not address the design project aspect of these courses. To date we have only offered one distance EE course at UW-RC and the course was team-taught, with the on-site faculty member handing the laboratory component of the class. Due to negative feedback from students during this summer experience future distance offerings were delayed at UW-RC until these problems have been addressed. Other logistical issues with distance education for non-traditional students included the availability of course software for off-campus use and how to handle office hours remotely. I recently collaborated on a UW-System grant proposal with

several other UW-Platteville EE faculty from main campus to develop distance courses and to address some of these problems.

Conclusions

Although the use of collaborative programs to meet the educational needs of place-bound electrical engineering students and the employment needs of local industry is a potentially good solution for both, there are still a number of logistical problems that need to be worked out. Ten EE courses at UW-RC and Seven EE courses at UW-FV will have been completed by the end of the Spring 2008 semester as part of this collaborative program starting in 2006. Initial feedback from students has been for the most part quite positive, however, as with any new venture, we have a lot to learn, especially in the offering of distance courses.

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