

AC 2007-846: THE DEVELOPMENT OF UNDERGRADUATE DISTANCE EDUCATION ENGINEERING PROGRAMS IN NORTH CAROLINA

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The Development of Undergraduate Distance Education Engineering Programs in North Carolina

Abstract

The College of Engineering at North Carolina State University has a strong track record in providing distance education to the citizens in North Carolina through credit-based courses and degree programs. To provide increased access to engineering education on the undergraduate level and enhance the success of the student transfer population, the College of Engineering developed two new 2+2 engineering programs and a distance education bachelor of science in engineering program.

The 2+2 programs are designed to provide students enrolled at institutions without engineering programs the opportunity to take some of the fundamental engineering courses in addition to their general education courses. After completion of the first two years, the students transfer to one of the Colleges of Engineering in North Carolina. Students who have the opportunity to take courses such as introduction to engineering, circuits, statics, and dynamics, are well-positioned to complete their education in only two additional years. The Bachelor of Science in Engineering distance education program combines the benefits of site-based and distance learning to students who cannot or are unwilling to relocate to the North Carolina State University campus in Raleigh.

In this paper we discuss the challenges and opportunities involved in working with our partner four-year institutions and community colleges in the development and delivery of undergraduate distance education programs and describe the benefits to the citizens of North Carolina and the participating institutions.

Historical Perspective

In his opening remarks to the 1995 Emerging Issues forum, Chancellor Emeritus Larry K. Monteith stated that one of the founding principles of North Carolina State University (NC State) was “the belief that education should not be confined within the walls of a building or the boundaries of a campus.” At that time, the College of Engineering already had a strong track record of providing distance education to the citizens and industry in North Carolina through credit courses, a degree program, and non-credit extension programs. In the 1994-95 academic year, the College of Engineering’s distance education programs accounted for 46% of the total enrollment of all NC State distance education credit programs combined.

The College of Engineering’s flagship distance education program in 1995 was the Video-Based Engineering Education (VBEE) program.¹ From 1985-1995, the VBEE program offered 524 courses to more than 6,500 registrants. A key component of VBEE was the Master of Engineering program. The Master of Engineering degree program is a distance-only, course-work based master’s degree. In 1995, 128 individuals had received their Master of Engineering degree. As of Fall 2006, 483 individuals have been awarded the degree. In addition to the Master of Engineering degree, the VBEE program offered:

- Five undergraduate courses
- A computer science certificate program
- A bachelor of science in engineering with emphasis in nuclear engineering. This program was industry sponsored and delivered in partnership with three community colleges.
- The Engineering Entrepreneurs Program seminar series (an engineering education coalition sponsored project) to students at NC A&T State University.

The College also had in existence at that time one site-based 2+2 undergraduate program located at the University of North Carolina Asheville.

To meet the demands of the adult part-time learner and other place-bound students, the College of Engineering felt it was important to develop effective methods of educational delivery that diminish the barriers of space and time. It was important to include students who were widely separated geographically and/or who were not able to attend lectures on a preset schedule. To address these needs, the College proposed to replicate the successful site-based 2+2 undergraduate program at two new locations and to develop a distance-based Bachelor of Science in Engineering at the University of North Carolina Asheville.

2+2 Engineering Partnership in North Carolina

In 1996, the State of North Carolina provided funding to North Carolina State University to provide increased access to engineering education throughout North Carolina by creating two new 2+2 programs in Eastern North Carolina. NC State was asked to partner with its sister Colleges of Engineering at NCA&T State University and the UNC Charlotte in developing and delivering these two new programs, which would be located at UNC Wilmington and Lenoir Community College.^{2,3} The addition of these 2+2 programs, when combined with the existing engineering programs at NC State, NCA&T, UNC Charlotte, and the 2+2 program at UNC Asheville, would provide access to engineering education in six of seven economic development regions in North Carolina and greater opportunity for citizens in underserved regions of the state. The benefits to the engineering colleges would be high quality, well-prepared transfer students. The benefits to the host institutions included an ability to recruit students they might not otherwise attract.

Each of the 2+2 Engineering Programs would have an on-site program director and an on-site support staff. The director would be an engineering faculty member who could serve as program director, facilitator for the courses delivered at a distance, coordinate and teach any required laboratories, serve as advisor to the student and do program marketing and outreach. If desirable, the program directors could also teach one of the distance-based courses. The staff member would handle course registration, provide office support and technical assistance. In addition, a program steering committee (composed of representatives from each of the three engineering colleges and the program directors) would coordinate the course offerings, policy issues, and general program oversight.

During the first two years, students are admitted to the host college/university, enroll in general education courses provided on-site by the host campus, and take engineering courses provided at

a distance by one of the participating engineering colleges. At the completion of the first two years, the students transfer to one of the engineering colleges and complete their degrees on-site. The engineering degrees are granted from the engineering college, although students at the community college could also receive an Associate of Science Degree.

The engineering courses offered during the first two years included introduction to engineering, statics, dynamics, electric circuits, and introduction to logic design, and introduction to computer organization. During the first four years of the program delivery of courses was shared among the three colleges of engineering. As technology, faculty and curricula changed, NC State assumed more responsibility for the 2+2 programs. By 2001, all distance courses were being delivered by NC State faculty.

Over the past twelve years, the technology has evolved substantially.^{4,5,6} However, throughout this time we provided a combination of synchronous and asynchronous lectures, along with the on-site laboratories. Courses have originated from all three colleges of engineering, as well as from the sites at UNC Asheville and UNC Wilmington. Whether delivery is synchronous or asynchronous, it is important that the technology be as transparent as possible, both to the instructor and to the students. The audio and whiteboard/document information is significantly more important than the video in most cases. The delivery system must include a real-time, high-resolution display on which the instructor must be able to point and draw, and asynchronous delivery alone is not good enough for the undergraduate population. Lectures were supplemented with live, two-way video-based office hours and/or problems sessions (on-site or live, two-way video). In addition, the instructors typically visit the remote sites 2-4 times per semester to get to know the students personally. On occasion, the instructor will originate a lecture from a visit site, provided the site has the requisite classroom facilities.

Bachelor of Science in Engineering

With the success of the 2+2 engineering programs, came more pressure from the citizens of North Carolina to have access to a four-year degree in engineering in both the eastern and western portions of the state. The idea for this program was first proposed to NC State by a group of business leaders representing the Western North Carolina Manufacturing Executives Association (MEA) who had observed that students who left the area to study engineering at NC State or one of state's other engineering schools rarely returned to Asheville after obtaining their degrees. To meet their needs, NC State pursued the development of a bachelor of science in engineering distance-based degree program in partnership with UNC Asheville. The program would be based at UNC Asheville, but the degree would be an engineering degree from NC State University.

Based on input from the Asheville community and the faculty at NC State University, it was decided that the most relevant focus for the degree program would be in mechatronics. A curriculum was developed and approval received from NC State, the University of North Carolina Office of the President and SACS to deliver this distance-based degree. The first two years of the degree program were built on the 2+2 curriculum already in existence. The remaining two years were composed primarily of engineering courses to be given by faculty in

the Departments of Mechanical and Aerospace Engineering and Electrical and Computer Engineering.

The BSE Mechatronics program was established in collaboration with UNC Asheville in 1998. An on-site director was hired to complement the existing 2+2 program faculty and staff. Soon after an additional faculty member was hired to help meet the on-site needs of the students. The educational objectives of the Mechatronics Program are:

1. To produce graduates who are able to apply the principles of mathematics, science, and engineering fundamentals, especially multi-disciplinary knowledge and skills in mechanical, electrical and computer engineering, and are able to design mechatronic components and systems to meet desired needs so they are prepared for successful careers in engineering or graduate school.
2. To produce graduates who are skilled at integrating and applying systems or devices incorporating modern microelectronics, information technologies and modern engineering tools
3. To produce graduates who possess professional interaction and program management skills, communicate effectively with team members and demonstrate the ability to work effectively on multi-disciplinary teams to achieve design and project objectives.
4. To produce graduates who are able to define, analyze and solve problems, especially those involving integrated mechatronic devices and systems, and are capable of developing, implementing and evaluating solutions via integration of their basic scientific skills, knowledge and creative thinking strategies in a quality committed environment.
5. To produce graduates who are able to understand and demonstrate their responsibility to their profession and society in a global, ethical and contemporary context and who are prepared for and realize the importance of life long learning.

The program has had five graduating classes from 2002 – 2006 with most of its graduates hired by firms in Western North Carolina. The curriculum requires 130 hours with nearly all of the engineering courses delivered at a distance. The BSE Mechatronics program is accredited by ABET, Inc.

Program Benefits

There are numerous benefits to these programs. The 2+2 engineering programs provide students with early exposure to engineering courses, early advising by engineering faculty, early introduction to policies and procedures at the colleges of engineering, early evaluation of transfer credit and an early introduction to the college of engineering computing environment. In addition, it provides students the opportunity to begin their college education closer to home and at a lower cost.

The distance-based bachelor of engineering degree provides the citizens in western North Carolina access to a four-year engineering program in mechatronics and flexible access for place-bound students in western North Carolina. A large fraction of the graduates of this program have stayed in the area after completing their degrees, thus fulfilling one of the primary objectives of the MEA.

Challenges

Although these programs have been successful, there have been a number of challenges we have had to overcome. Challenges include: registration processes, tuition and fees, academic calendars, coordination of class scheduling among the institutions, access to the same technology, advanced preparation of lecture materials, timely return of graded homework and tests, and cost of program delivery. Each of the six institutions that have participated in the 2+2 programs has different registration processes and procedures. Even though five of the institutions are all part of the University of North Carolina System, there is not a common registration process. Our goal was to have the students register for their courses at one institution and work out the logistics behind the scenes. This was not always possible. Multiple registrations cause frustration on the part of the student and the program administrators and can have implications on a student's eligibility for athletics and financial aid. Similarly there are differences in tuition in fee charges among the campuses.

One of the on-going challenges each semester was the difference in the academic calendars and class schedules at the individual institutions. Although the 58 campuses in the community college system have moved to a common calendar and common course numbering system, the sixteen campuses in the UNC System have not. Start and end dates are different, vacation dates are different, as are class times. Another ongoing challenge is coming to agreement on what technology will be used, how it evolves over time, and who is responsible for the costs of implementation. In fact, cost of program delivery is in general a challenge.

Another set of challenges evolves around the course instructors. Because of the potential for technology problems, it is important for the students to have copies of the lecture materials before the lecture begins. This requires a commitment on the part of the faculty to be prepared early. It is also important for the distance students to have their homework assignments and tests graded and returned in a timely fashion. Finally, it is important that the students at the remote locations have the opportunity to interface with the instructors at least once, preferably 2-4 times, per semester.

Summary

To ensure the success of the program and the students enrolled in the program, there must be an on-site champion for the program. The program champion must be involved in the academic program activities on the engineering campuses and in the academic program activities on the host campus. There must be careful coordination with all program partners. The program must have a reliable, high quality, and well-supported technology infrastructure for program delivery and faculty-student communication. Partner institutions must have adequate laboratory facilities and support. The engineering faculty must periodically visit with partner campus faculty and students. Communications among all partners, faculty and students is essential.

Partnership programs provide unique access to engineering, for example engineering in a liberal arts environment. Developing joint programs with selected institutions can enhance the success of transfer students, but successful programs do not come without cost, both in personnel and

technology. However, new opportunities abound both for the 2+2 type programs and four-year degree completion programs. With careful planning and management, these programs can provide benefits to all.

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