

Establishing a Partnership to Deliver Baccalaureate Engineering Technology Programs to Location-Bound Non-Traditional Students

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Abstract

Ohio's Upper Miami Valley is a rural region extending approximately 30-60 miles north of Dayton. The region is heavily industrialized with manufacturing representing 36 percent of employed persons aged 16 years and older. A 2001 survey of Edison Community College graduates and regional employers showed a strong demand for engineering technologists. Survey respondents expressed a need for a baccalaureate degree that would permit employees to continue with their job and family responsibilities.

The University of Dayton, the only institution within a fifty-mile radius to offer baccalaureate engineering technology degrees, committed to investigate a partnership that would meet the needs of Edison's service area. Representatives of the two institutions crafted an articulation agreement to link their respective engineering technology curricula. The University of Dayton Department of Engineering Technology subsequently committed to offer upper level classes leading to a baccalaureate degree in four of its engineering technology programs – electronic, industrial, manufacturing, and mechanical. During Summer 2002, equipment was installed at both institutions to facilitate IP-based videoconferencing, and in Fall 2002, the first classes were offered.

Establishing this program has not been without incident, however both institutions are committed to its ultimate success. Issues dealing with coordinating schedules at both institutions, technology problems, and course logistics had to be overcome. Furthermore, since the University of Dayton programs are TAC/ABET accredited, assurances had to be made that students at both institutions are treated equitably, and the course outcomes would be achieved independent of the student's location. Finally, faculty at both institutions have to be well versed in each other's programs to assure that UD students enrolled in off-campus classes were properly advised. Overall, this partnership demonstrates a commitment to meeting the educational needs of a neglected population.

Background

In Fall 2001, Edison Community College (ECC) in Piqua, OH, began investigating articulations between their associate degree engineering technology programs and other institutions offering baccalaureate programs in engineering technology. Edison's ultimate intention was to bring degree-completion programs in engineering technology to their campus to serve the needs of area technicians. An Edison survey of graduates and regional employers showed a strong demand for engineering technologists. Survey respondents expressed a need for a baccalaureate degree that would permit employees to continue with their job and family responsibilities, and only three out of the 72 individuals desiring a program said they preferred to attend full-time. Of the 29 employers, 27 said they would encourage their associates to attend a baccalaureate program. Based on the results of the survey, Edison's goal was to serve two distinct populations of students: the traditional student who desires to pursue a baccalaureate degree in engineering technology in a 2+2 manner, and the location-bound non-traditional student.

The University of Dayton, the only institution within a 50 mile radius of Piqua that offers baccalaureate engineering technology degrees, has a history of accepting traditional students from ECC into its curriculum. These students have progressed well through the UD curriculum, demonstrating that the ECC engineering technology programs provide a solid foundation for students to succeed in the rigorous UD programs. For this reason, engineering technology faculty were optimistic about developing a formal articulation agreement.

During the Fall 2001 semester, UD engineering technology faculty worked with ECC faculty to develop a strong articulation agreement that permits students to enter UD with a sufficient number of credits to maintain Junior status. UD faculty reviewed every math, science, and technical course in the ECC engineering technology programs. This included programs leading to an associate of applied science degree in Electronics Engineering Technology, Industrial Management, and Mechanical Engineering Technology. Since each of the programs had multiple options, evaluation of transfer credits yielded eight (8) pathways for ECC students to receive a UD bachelor of science degree in engineering technology. During the evaluation process, ECC faculty responded by altering their programs to better match the UD programs, and developed a "bridge" program to better prepare students in math and sciences.

The articulation agreement was completed and approved by the administration at both institutions early in 2002. Subsequently, planning began for delivery of UD classes.

Implementation of the Agreement: Traditional Students

Traditional students can make a seamless transition from Edison Community College to the University of Dayton. For many students, however, the biggest impediment to attending UD is the cost. As a private institution, the University of Dayton's tuition is over six-times the cost of Edison Community College tuition. Furthermore, transfer students have less opportunity for scholarships and tuition assistance than those admitted to UD in their first-year. For this reason, the Department of Engineering Technology received approval to institute a Dual Admission program modeled after the very successful program instituted at Sinclair Community College

(SCC). As in the Sinclair program, Edison Community College students who intend to complete their degree at UD would apply for admission based on their academic credentials midway through their associate degree program. Upon successful completion of an approved ECC program, students immediately enroll in a UD engineering technology program. As in the Sinclair Dual-Admission model, students admitted to the UD program automatically receive a scholarship equal to one-third of the UD tuition.

Implementation of the Agreement: Location-Bound Students

For the non-traditional, location-bound student, a separate program was instituted, especially since enrolling this population of students into the program presents more of a challenge. Because these students are typically working full-time, they would be limited to a few classes each semester. Surveys have shown, however, that the fifty-minute commute from Piqua to Dayton is a significant deterrent. Therefore, it was agreed that all of the technical courses be offered on-site at Edison Community College. ECC has partnerships in place and currently delivers baccalaureate degrees to their students in various disciplines and delivery modes from Bluffton College (Organizational Management), Franklin University (Business Administration, Computer Science, Healthcare Management, MIS, Public Safety Management, Technical Management, and Digital Communications.), and Urbana University (Business Administration). The UD partnership is the first to provide support for students enrolled in the engineering technology curricula.

Since it was important to adhere to the University of Dayton's mission of "Connected Learning and Scholarship," the possibility of offering the classes in an asynchronous mode was immediately ruled-out. Faculty felt that this population of students should still be a part of the UD community, have full access to University resources, and interact fully with faculty and other students in the program. Furthermore, UD faculty justified that if the same faculty offered classes in both Dayton and Piqua, and if the same equipment were utilized for labs, the program at ECC could be justified under TAC/ABET (II.B.10)¹ criteria to be "accredited as integral with the regular on-campus program." The only viable option would be to bring Dayton faculty to Piqua, but the full faculty loads and scarce additional resources quickly eliminated hiring additional faculty to commute to Piqua for each class. All parties involved agreed that, at present, the best mode of delivery is to use real-time videoconferencing to extend the Dayton classroom to Piqua. A cost analysis using the VTEL calculations² demonstrated that using videoconferencing technology would save the University approximately \$11,500 annually over sending faculty each class period to Piqua. Table 1 summarizes the cost analysis.

The UD Department of Engineering Technology designed a program to offer four baccalaureate degree programs on-site at Edison Community College: Electronic Engineering Technology (EET), Industrial Engineering Technology (IET), Manufacturing Engineering Technology (MFG), and Mechanical Engineering Technology (MCT). The required courses, many of which fulfill requirements in multiple programs, include approximately 14 ECT courses, 10 IET courses, 9 MCT courses, and 3 MFG courses. This amounts to approximately 36 UD engineering technology courses that need to be redeveloped for distance delivery. In addition, one math course will be delivered and a selection of general education classes will be made available through the University's Summer Distributed Learning program. The program is designed so that ECC

graduates can complete their BS degree at UD within 4 years.

Classes are scheduled to run simultaneously in the two locations, and the students in both locations could interact with faculty and other students. A digital videoconferencing (DVC) system coupled with the current University e-learning infrastructure provides a well-connected community of learners. Since the target population for these courses is over 24 years of age and taking classes on a part-time basis, they are eligible to apply for enrollment through the University of Dayton's Adult Degree Advancement Program (ADAP). In this program, all students pursuing a degree in engineering technology are granted a tuition reduction equal to 40% off the regular tuition rate.

Table 1. Total Cost of Ownership Analysis

Item	Description	Cost
Start-up Cost for DVC System	Includes all design, engineering, equipment, and installation costs.	\$46,118
Annual Cost for Conventional Classes	Includes cost of additional faculty, travel, faculty lost work time.	\$29,424
Annual Cost for DVC Classes	Includes 5-year depreciation of start-up costs, faculty stipend for creating electronic materials, ECC facility rental.	\$17,924
Annual Savings		\$11,500

Technology

A videoconferencing system was purchased and installed in the University of Dayton Department of Engineering Technology. The ISDN & IP capable compressed-video system was installed in an 830 ft² Engineering Technology classroom, and a connection to department's network provided the communications link. This system was installed with cameras at both the front and rear of the room to facilitate viewing of either the instructor or the students. Other equipment installed in the room included a SMARTBoard interactive whiteboard, LCD projector, document camera, VCR, eight ceiling mounted microphones, stereo speakers, 32" monitor, and the associated video and audio distribution amplifiers. All of the equipment is controlled through a single SmartPanel control panel. The \$46,000 to fully equip this classroom came from a \$14,000 bequest to the Department of Engineering Technology, with the remainder allocated from department and School of Engineering funds.

The 450 ft² classroom at Edison Community College is similarly equipped with a compressed-video system, two cameras, monitors, VCR, and LCD projector. At approximately \$20,000, the a smaller videoconference system was installed, and the interactive whiteboard, audio and video distribution amplifiers, and control panel were omitted from the design. The layout of the UD and ECC classrooms is shown in Figures 1 & 2, respectively.

Using this technology and careful scheduling of classes, UD engineering technology students at two locations (Piqua and Dayton) participate in classroom learning simultaneously, and are able to seamlessly interact faculty and peers. Use of existing resources including the Lotus Learning Suite (LearningSpace, QuickPlace, and Sametime) provide enhancement to both groups of students, and support the University's connected learning mission. Furthermore, to increase the sense of community for students at ECC, University of Dayton faculty travel to Piqua approximately three times during the semester for live delivery of course materials, and videoconference back to Dayton students.

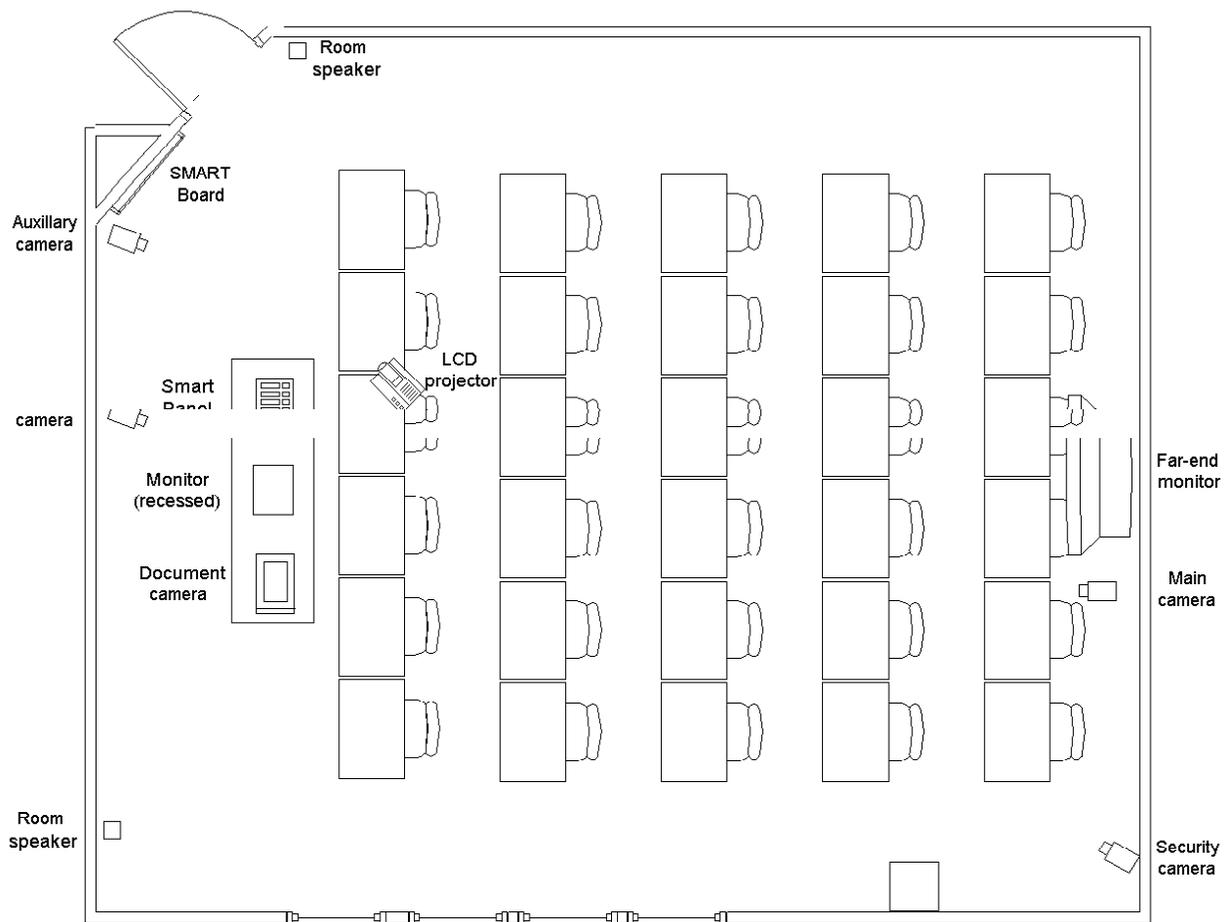


Figure 1. UD Distance Learning Classroom

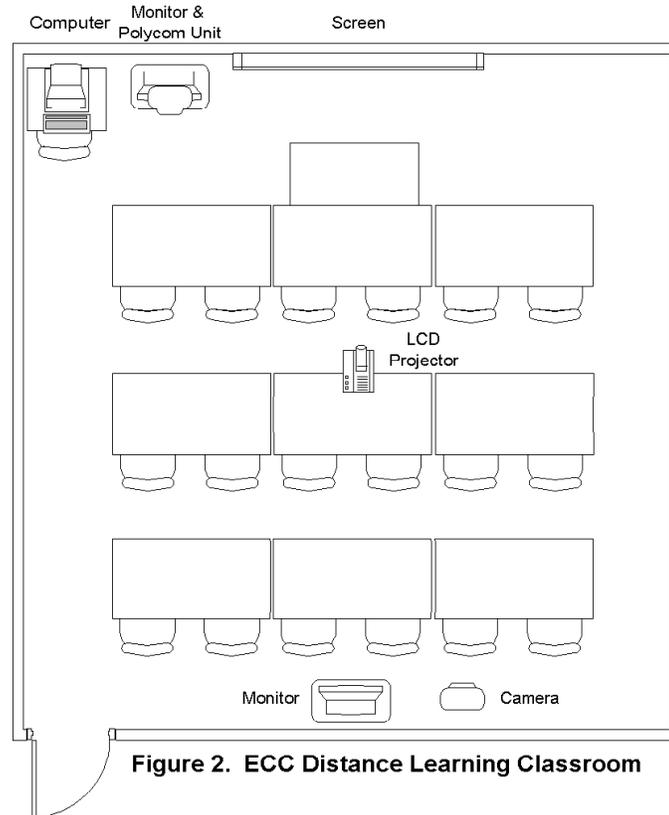


Figure 2. ECC Distance Learning Classroom

Using the available technology, support for students is not limited to faculty office hours. All students are able to synchronously interact with faculty. Local students may choose face-to-face interaction, but all students are afforded interaction during prearranged times using the chat and whiteboard features of Lotus Sametime. Documents normally distributed in class are posted on the Lotus LearningSpace dedicated to each class, and discussion of key topics can extend beyond class time though the use of the threaded discussion and document sharing features of Lotus QuickPlace.

To facilitate the use of technology to support classes, all distance students are required to have access to a PC, in the same manner as is required for full-time traditional students.

Program Launch

In Fall 2002 the first two classes in the program were offered: Manufacturing Design (MFG 240) and Project Management (IET 323). MFG 240 enrolled a total 19 students – 13 in Dayton, and six in Piqua. IET 323 had enrollments of 34 and 13 in Dayton and Piqua, respectively. Full-time faculty members at Dayton instructed each class, with students in Piqua participating though the videoconferencing system. To treat students equitably at each site, all supplemental classroom materials (handouts) were either posted on the class Web site, or e-mailed individually to the students. Assignments that were due at class time were either hand-delivered to the instructor, or submitted by e-mail or fax prior to the deadlines. Faculty coordinated their exam and student

presentation schedules to allow for one faculty member at each site when necessary.

Upon completion of the semester, faculty were particularly interested in the student evaluations of each course. The results showed no appreciable difference in the quantitative results for “overall quality of the course” and “overall quality of the instructor” between Dayton and Piqua sections of the class. In the written comments, Piqua students were somewhat frustrated with the initial technology problems, but expressed appreciation of efforts to bring the classes to them. Students offered positive feedback on how to work around some of the potential technology problems. Dayton students were less tolerant. Many saw the problems with technology as a distraction, and were disappointed that the use of technology appeared to have slowed the pace of the course and affected the continuity of the lectures.

With many of the technology issues either resolved or addressed, two additional classes began in January 2003: Electrical Circuits I (ECT 110), and Static & Dynamics (MCT 220). Two full-time faculty are leading the instruction, and have learned to adjust their teaching styles and classroom presence to better integrate the courses with the technology.

Issues Encountered

Most new programs are not without their share of problems, and coupling this with the use of a relatively new technology has compounded the stress of personnel at both institutions. Some of the issues encountered and their outcomes are indicated below.

ISSUE: Class Scheduling. Since sections run simultaneously at both institutions, class schedules need to be coordinated. Both institutions run on semesters, so the course calendar is similar, but class periods are different. Also, the University of Dayton, a Catholic institution, and Edison Community College, a state institution, have different holiday schedules.

OUTCOME: The Chair of Engineering Technology at UD and the Dean of Engineering Technology at ECC were in frequent contact during the scheduling period. Both institutions agreed to use the UD calendar and class time period. In one instance (Veteran’s Day) while ECC was closed and UD had classes scheduled, special arrangements had to be made to provide student access to the classroom and insure technical support was available.

ISSUE: Student Access to UD Services. Issues such as getting books and computer account information to the students in Piqua, student advising, and office hours had to be as seamless as to them as it is to Dayton students.

OUTCOME: Textbooks are ordered through the UD bookstore online and mailed to students, and special arrangements were made to permit a designated UD faculty member to obtain all Piqua student computer account information. Student advising and faculty office hours are handled through e-mail and phone contact, and time is made available through the videoconferencing unit before and after class for students at the far-end.

ISSUE: “Echo” in the audio signal.

OUTCOME: The initial installation was designed to have eight ceiling-mounted microphones installed in the videoconference classroom at UD. The theory was that natural conversation could

occur independent of the location of students or faculty in the classroom. However, due to the acoustics of the room and the necessity for speakers, the videoconferencing unit's echo canceling software was not able to eliminate the sound distortion. UD responded by turning off all but one ceiling-mounted microphone in the back of the room, and installing a lavalier microphone for the presenter. This dramatically improved the quality of the audio presentation.

ISSUE: Network and Connection Inconsistencies. Integrity of the connection has to be consistent throughout the class.

OUTCOME: There are numerous issues that were encountered dealing with the connection. At the onset of the project, the initial communication between the institutions was an issue. OARnet, the Internet Service Provider (ISP) for educational institutions throughout the state of Ohio recommends that, because of the complexity of the H.323 protocol, all videoconferencing units be placed outside of the firewall³. In their words, "videoconferencing equipment and firewalls don't play well together." The University of Dayton Information Technology (UDit) personnel, however, have undertaken the challenge to put the connection through the firewall. After six-months of service, the efficacy of this method is still up for debate. The second issue deals with bandwidth. The University of Dayton ranked as the top-wired university on Ohio and the 16th most wired university nationally by *Yahoo! Internet Life*. Consequently, Internet usage is very high, and students using application exchange programs such as Kazaa and Nutella to swap video and MP3 files consume a great deal of bandwidth. Furthermore, as a primarily residential campus with the majority of classes offered during the day, student use of the Internet is highest between the hours of 5pm and 9pm, the same hours as the videoconferencing classes. UDit responded by segmenting the bandwidth and giving priority to the IP address required for the class.

The bandwidth issue is still not resolved, and students at the far end report sporadic slow communication verified by ECC networking personnel as high packet loss. As a temporary solution, until the bandwidth issue is resolved, UD installed high-end conference phones at both sites to transmit the audio signal. Before each class, if there is an indication that slow network connections are present, a phone call is initiated for audio, while video is still transmitted via the Internet.

ISSUE: Students at both ends are to be treated equitably. Information distributed in class had to be available to all students.

OUTCOME: Faculty abandoned the practice of using the traditional "handouts" and instead post all class materials electronically. The University's use of Lotus LearningSpace permitted faculty to make all class materials available electronically for all students. For assignments that are better suited to paper than electronic medium (quizzes, homework, etc.) students in Dayton hand them directly to the instructor at the beginning of class, while Piqua students submit their materials via fax. All correspondence to students outside the classroom is handled through e-mail

ISSUE: Faculty Learning Curve. Some faculty are more comfortable with the technology than others.

OUTCOME: Novice faculty preparing for their first distance learning class work with experienced faculty to assess equipment usage and interaction with students. Faculty sit in on each other's classes and do informal peer reviews until each reaches their own style and comfort

level with the technology. Faculty also need to realize that because of the extensive uses of technology and the small communication delay between sites, the pace of the class is somewhat slower than a more typical lecture class.

Future Plans

The University of Dayton and Edison Community College are working jointly to strengthen the partnership formed by the articulation agreement. There are a few items that still need to be addressed to make the 2+2 transition truly seamless. There is an issue of transfer efficiency of credits from the associate to the baccalaureate degree programs. Currently, only about 75% of Edison credits can be applied to UD engineering technology programs. With curriculum committees at each institution working together, changes can be instituted to increase the number of credits that will transfer.

Also within the scope of this partnership, Edison will prepare its programs for TAC/ABET accreditation. UD's engineering technology programs have been accredited since the 1950's. This accreditation experience will be useful as UD faculty mentor Edison faculty and administration as they work on revising their curriculum to prepare for an accreditation review.

Finally, based on the early success of this program, both institutions will investigate expanding the distance learning aspect of the partnership to include daytime classes. This will provide the opportunity to capitalize in the strengths of each institution and offer additional technical classes without a significant drain on existing resources.

Conclusion

Overall, the partnership between the University of Dayton and Edison Community College serves to meet the educational needs of a rural population of engineering technicians. Such a partnership provides for educational opportunities that would not otherwise be available. As an added benefit, this partnership should also increase the enrollments at both institutions.

While there have been some issues relating to the technology, students and faculty have been extremely patient. The encouragement from students indicates that the partnership is working, and deserves to be fostered.

References

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