

AC 2008-1450: BUILDING ACADEMIC PATHS IN ENGINEERING AND TECHNOLOGY FOR UNDERREPRESENTED STUDENTS

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Building Academic Paths in Engineering and Technology for Underrepresented Students

Abstract

We wish to report in this paper the challenges and successes in creating and implementing joint/dual programs in engineering and the potential such programs have for increasing the number of traditionally unrepresented groups in science, mathematics, engineering and technology. We will describe along with the curriculum of the program the administrative infrastructure that is necessary to produce and sustain a smooth process for moving the student from the campus of the two-year institution (community college) to that of the four-year institution (senior college). We will demonstrate how the relative location of the community and senior colleges' campuses can be exploited to the advantage of the student and how location can sometimes limit certain options in a joint/dual program. We further assert that such programs are an effective means of addressing a critical challenge in the engineering community (namely the lack of underrepresented students in engineering) economically.

Introduction

The transition from a two-year program to a four-year program can sometimes be difficult for students, particularly those students from traditionally underrepresented groups. Robust and fluid articulation agreements between the two-year and four-year schools can go a long way to minimize the difficulties experienced by students when transferring to a senior college. We reported the collaborative efforts of a two year and four year college to create and implement a jointly registered, dual admission program in engineering. One goal of this report is to give an update on the progress of that collaboration¹. In the summer of 2002, Eugenio Maria de Hostos Community College (HCC) and the Grove School of Engineering (GSOE) of the City College of New York (CCNY) created a jointly registered, dual admission program in Electrical Engineering. The program was designed to meet the guidelines of the Accreditation Board for Engineering and Technology (ABET) and provide HCC students with the same curriculum of the first two years of the existing four year Electrical Engineering (E.E) program required at CCNY. Students entering the program are admitted to both HCC and CCNY and for those students that successfully complete the Associate of Science (A.S.) degree in Electrical Engineering Science at HCC they are granted admission to the GSOE at CCNY. HCC is located in the South Bronx, in one of the poorest congressional districts in the country, with a large population of underrepresented students consisting of 80% Latinos, 29% African American and 77% women over the age of twenty-five. With the GSOE a short bus ride away (1.4 miles) from HCC, students in the joint/dual program have easy access to both campuses. This allowed them to take courses at the GSOE that are not offered at HCC. The benefits to students, following the community college track, taking courses at a 4-year college are significant. In a recent report, Adelman² demonstrated that community college students who were likely to persist and complete a degree, tended to be in a collegiate track that required them to transfer to a 4-year college to attain a bachelor's degree. Along with an increase in persistence, a community college student who takes courses at a 4-year institute, while still a student at the 2-year school, is in a better position to reduce the negative impact of the culture change, that is manifested in

the lowering of their GPA, often experienced by transfer students who move to a new academic institution (and environment).

Curriculum

As in any academic program, the development of a cohesive curriculum is important, particularly when the program extends across departments, learning environments and academic institutions. The perspective of the community college on curriculum and the transferability of courses can be quite different from that of the 4-year institution. During the process of developing an articulation agreement, it is not unusual for the community college to ask for a number of core pre-engineering courses (e.g., calculus, physics, chemistry, Engineering Design) that the community college student could use to transfer into the engineering (and computer science) program/s at the 4-year institution. These core courses are selected so as to reflect the first two years of a four- year engineering program. While this model is certainly reasonable, it does have some major weaknesses. Many engineering schools have engineering programs in classic areas such as civil, chemical, electrical and mechanical engineering with a number of courses, in mathematics and science, in common. However, the first two years of an engineering program can have subtle but significant differences in course requirements that are specific to that major. If the new transfer student stays on track with their initial choice for a major, there is no problem. But, should the student decide to change majors when transferring to the 4-year institution, that decision could cost them time and money and it could have a negative impact on their motivation to attain the bachelor's degree. Students should be made aware of the pluses and minuses of a change of major so that they are given the opportunity to make a well inform decision. Note, this information should be given to them at the beginning of their academic experience at the community college.

The variation in the curriculum of the first two years of engineering programs may become greater as more areas of studies in engineering grow, as colleges and universities respond to the growth in technology and its application. The one size fit all theme of the core pre-engineering course model for articulation agreements would not be ideal when addressing the issue of different course requirements in the first two years of different engineering majors. The core pre-engineering course articulation model can also be problematic when advising transfer students. Since, the pre-engineering courses are not aligned with a specific area of study or major, there is the opportunity for the misinterpretation of which group of courses belong to a given major, which could ultimately lead to the student being misadvised and taking courses they do not need. We also must consider how the pertinent details of the articulation agreement will be promulgated from advisor to student, administration to student, academic division to academic division, and 2-year college to 4-year college and back. Having a clear and concise document, for each engineering track, detailing explicitly the courses, the course sequences and degree requirements from the community college and the senior institution, can go a long way to reduce any confusion an engineering student or an academic advisor might have about the path to attaining an engineering bachelor degree. The HCC and GSOE team choose to specify the necessary courses and the course sequence in constructing the joint/dual electrical engineering program with HCC and the GSOE.

The joint/dual program requires that students first earn the Electrical Engineering A.S. degree. This part of the program is housed in the Mathematics Department at Hostos Community College. The program consists of courses required in the first two-year of the four-year engineering program at City College. After completing 60 credits of mathematics, science, general education and introductory engineering courses the student will have earned an A.S. degree in Electrical Engineering and then may transfer to the Electrical Engineering program at City College to complete the requirements for the B.E. in Electrical Engineering. On average the student can take 15 credits each semester to complete the bachelor program in nine semesters. Shown below is the full curriculum for the joint/dual program. In designing this new program both schools worked diligently to make sure that it would meet the Accreditation Board of Engineering and Technology (ABET) 2000 criterion consisting of eleven (11) student learning outcomes and assessment

**Eugenio Maria de Hostos Community College
and**

The City College

March 10, 2003

JOINT PROGRAM IN ELECTRICAL ENGINEERING

Hostos

First Year – Fall *	Credits	Spring	Credits
MAT 1642 Calculus	4	MAT 1644 Calculus II	4
ENG 1302 Expository Writing	3	English 1303 Literature and Composition	3
CHE 4002 General Chemistry I Lecture	3	Soc 1232 Introduction to Sociology	3
CHE 4102 General Chemistry I Lab	1	MAT 1698 Modern Programming	3
Psychology 1032 General Psych	3	Liberal Arts Elective†	1
		ENGR 10100 Engineering Design I	Waived
Total	14	Total	14
Second Year – Fall			
	Credits	Spring	Credits
MAT 1646 Calculus III	4	MAT 1742 Ordinary Differential Equations	3
PHY 4502 General Physics I	4	***ENGR 20400 - Electric Circuits	3
***ENGR 10300 – Computer-Aided Analysis Tool for EE	2	MAT 1722 Linear Algebra with Vector Analysis	3
** ENG 1340 Technical Writing	3	PHY 4504 General Physics II	4
VPA 3612 Fund of Public Speaking††	3	Liberal Arts Elective	3
Total	16	Total	16

TOTAL HOSTOS CREDITS 60

Associate in Science in Electrical Engineering Science (AS)

† Students who continue for a bachelor's degree at CCNY must complete 3 credits of history from the list below.

Liberal Art Electives to be taken from:

HIS 4668 Ancient, Medieval, and Early Modern European History, HIS 4670 Modern European History, HIS 4660 World History To 1500, HIS 4661 Modern World History, ECO 4645 Macro-Economics, ECO 4643 Micro-Economics, POL 4701 American Government, HUM 3021 Diversity and Pluralism in America, VPA 3502 Arts and Civilization I or VPA 3552 Music Appreciation.

CCNY

Third Year – Fall	Credits	Spring	Credits
EE 2100 Switching Systems	3	EE 30600 Linear Systems II	3
EE 20500 Linear Systems I	3	EE 31100 Prob. & Random Proc.	3
EE 22100 EE Lab I	1	EE 32200 EE Lab II	1
EE 24100 Electronics	3	EE 33000 Electromagnetics	3
EE 25900 Programming for EE	4	Lecture Elective	3
		EE 34200 Electronics II	3
Total	14	Total	16
Fourth Year – Fall			
	Credits	Spring	Credits
EE 31200 Communication Theory	3	EE 44100 Electronic Devices & Semiconductor Matls	3
EE 32300 EE Lab III	1	EE 44400 Digital Computer Systems	3
EE 33300 Ant., Microwaves & Fibers	3	Engr 230 Thermodynamics	3
EE 33900 Semiconductor Materials & Devices	3	Lecture Elective	3
EE 37100 Linear Feedback System	3	Lecture Elective	3
Lecture Elective	3		
Total	16	Total	15
Fifth Year - Fall			
EE 42400 EE lab IV	1		
Lecture Electives	6		
Design Elective	3		
Lab Elective	1		
Practical Issues	3		
Total	14		

TOTAL CCNY CREDITS 75

TOTAL DEGREE CREDITS 135

Bachelor of Engineering in Electrical Engineering - BE(EE)

†† Students who complete VPA 3612 at Hostos, must take an additional three (2) credits of liberal arts at CCNY.

* Students needing remedial or compensatory courses will require additional credits for graduation.

** New course

*** Course will be co-listed. Students will be given a permit to attend CCNY until such time as there is sufficient enrollment to offer the course at Hostos.

- All first-time freshmen must take SSD 1000: “Critical Skills for the 21st Century.”
- The College requires successful completion of the CUNY tests in reading, writing and mathematics; the College Proficiency Examination (CPE) and 16 CPI units as required (see College Catalog).

The Process

Joint/dual enrollment programs along with transfer agreements and articulation policies have become more and more complex with higher education wrapped in a web of federal and state agencies, accrediting bodies, administrators, faculty and staff³. Communication, trust, and mutual respect between institutions are paramount in developing a fluid system that allows students to progress from one higher education program to the next⁴. While the success of the actual joint/dual program between Hostos and City College, which began in the fall of 2003, is evident by the 100 students who are currently in the program, we do feel that the process used to develop it was extraordinarily fruitful. In this paper we would like to share that experience in the hope that other institutions may find it useful. The initial steps in creating the dual/joint program consisted of a number of lengthy telephone calls and campus visits by the Deans of each school. These discussions were open and honest and were a way for each school to get to know the other and find out what was most important to them. A team representing Hostos consisting of the Dean and Assistant Dean of the Office of Academic Affairs, and a similar team representing City College consisting of the Dean and Associate Dean of the School of Engineering drafted a proposal for the curriculum of the new joint/dual program. The two teams worked together to resolve potential administrative and curriculum issues such as course substitutions, course credits and contact hours. When it came time to decide on course content and the feasibility of the entire program, department chairs and faculty from each school became involved. Course syllabi were exchanged along with ideas about upcoming changes in the curriculum. This important part of the process insured that the curriculum would be current and helped to establish a relationship between the two schools that extended beyond the office of the deans. It also strengthened the relationship between the two schools.

After several months of meetings and numerous versions of the original proposal the dual/joint Associate in Science (A.S.) in Electrical Engineering Science and Bachelor of Engineering in Electrical Engineering (B.E.) program was ratified by Hostos Community College, the Grove School of Engineering of the City of New York and the City University of New York.

The documentation of the articulation agreement is important and necessary, but is not sufficient. The infrastructure to support the program and most of all the students who participate in it was critical. We had to develop a process for moving the students smoothly from one campus to the other.

Below is a short list of some of the challenges we faced:

1. Identification of students in the program to insure proper advisement by academic advisors in the GSOE.
2. Advisors on both campuses needed access to student records on the other campus to keep track of student’s academic performance, particularly for those students who are taking courses on both campuses.
3. The suspension of the filling out of any application normally required by transfer students.

4. Early online registration at the GSOE for students in good academic standing. A privilege that is generally only extended to continuing engineering majors at the GSOE.
5. Updated list of students in the program.
6. The admissions procedure and transfer evaluation process for students who transfer to HCC into the joint/dual engineering program.

Below are the processes for working with engineering students in the various stages of the program. In the first phase of the program the students work towards earning the Associate Degree in Engineering Science. In the second phase, the students focus on earning the Bachelor Degree in Engineering.

Phase I. Associate Degree in Engineering Science

In phase I of the program, students are allowed to take certain required engineering courses on permit at CCNY in order to satisfy the requirements of the Associate Degree in Engineering Science. Students that are in good academic standing and have all necessary requisites will be allowed to register, via e-permit, for engineering courses at CCNY during the early registration period -this occurs around May for Fall registration and December for Spring registration. Currently these students are not able to do on-line registration for engineering courses at CCNY. They are registered for courses as prescribed in the curriculum above by an advisor in the GSOE. The procedures are as follows:

1. A list of current students are sent to the GSOE from HCC
2. The students will apply for an e-permit at HCC for the required engineering course/s. His/her transcript will be checked by a HCC Advisor to insure that they have all the necessary requisites.
3. The Hostos academic advisor/dean OKs the permit.
4. An engineering advisor from the GSOE registers the student in the required course.
5. After the student has completed the course the CCNY Admissions Office will forward the final grade/s to the Admissions Office at HCC.

Phase II. Bachelor Degree in Engineering

In phase II of the program, students with the Associate degree in Engineering Science (A.S.) work towards earning a Bachelor of Engineering degree from the GSOE at CCNY. These students are physically on the CCNY campus and will have access to early on-line registration. Unlike the case for all other transfer students, JP students are waived all application and processing fees associated with transferring from HCC to CCNY. These students should have already had contact with engineering advisors during their tenure at HCC and should require only a brief reevaluation of their transcripts as a check and balance of the program.

Conclusion

Today many students are attending two-year schools as the first step to obtaining a bachelor's degree. Transferring from a two-year program to a four-year program can be perilous particularly if there is little communication between the institutions. It is imperative that community colleges and universities collaborate to develop a seamless transfer process for these students.

¹ Walser, A. D., Karim, M., "Developing a Joint/Dual Program and It's Impact on Underrepresented Engineering Students", Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition, Session No. 3270.

² Adelman, C. 2005, "Moving Into Town-and Moving On: The Community College in the Lives of Traditional -age Students. Washington, DC: U.S. Department of education

³ Tobolowsky, B., "Improving Transfer and Articulation Policies", ERIC Digest (ED416934), 1998. Website URL [<http://www.ericfacility.net/databases/ERIC>], site accessed January 5, 2004.

⁴ Morphew, C. C., Twombly, S. B., Wolf-Wendel, L. E., "Innovative Linkages: two urban community colleges and an elite private liberal arts college, Community College Review, Winter, 2001.