Pipeline to Engineering Diverse Future in New York City.

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Abstract

The Grove School of Engineering at The City College of New York has developed partnerships with its sister institutions, LaGuardia Community College and Hostos Community College. They serve as a pipeline that strengthens Grove's commitment to student diversity (women constitute 16.36% and under-represented minorities represent over 40% of its 2008-2009 undergraduate population). As the admissions standards for The Grove School become more selective, the need for access to an engineering education for disadvantaged students, especially recent immigrants with English as a 2nd language and inner-city secondary school graduates from less academically-rigorous preparatory backgrounds, is critical. These students would face difficulties in securing admission into City College at the freshman level. Instead of steering them away from engineering as a major, these students would now be able to be oriented on the foundations of the major while determining whether it is the right choice.

Competition for acceptance into a quality engineering program is becoming increasingly fierce. The price tag for a private education within urban America cost significantly more than the Grove School. These joint/dual degree programs are an opportunity for less-prepared students to develop the skills, knowledge base, and academic/personal preparation at the community college, before gaining formal admissions into Grove's competitive engineering programs. Community college participants pay lower tuition and are able to work to finance their education. Articulation guarantees that all credits count towards the engineering degree. Exposure to the engineering culture includes taking engineering courses, participating in engineering student activities, and registering at the same time as City College's students. These programs provide access while facilitating a comprehensive support structure, including dual academic progress monitoring, that empower these students, with the tools and resources, to make more informed decisions. The infrastructure of institutional partnerships that facilitates such development and catalyzes such a mission would encapsulate the strengths of these programs. This paper will present best practices in program operations that involve partner stakeholders in areas such as advisement, orientation, communication, enrollment management, and administration coupled with a discussion on lessons learned, major challenges, and program outcomes assessment as pertinent to enrollment and graduation of females and minorities.

Introduction

With the downturn in the economy, some students who were attending private schools with more costly price tags are transferring to public institutions of higher education. There are also some new college freshmen who may have selected private schools who are also opting to attend public colleges and universities. This economic phenomenon is affecting colleges and universities that traditionally accept students from disadvantaged backgrounds by making them more competitive to the students that they traditionally serve. At The Grove School of Engineering of The City College of New York, the downturn in the economy did result in a

higher consumer demand for an engineering education especially from students who may have selected to attend a private school in the past. However, The Grove School of Engineering has been working on its admissions criteria to accept students who are better prepared to succeed in the engineering curriculum. This shift in momentum from a School of Engineering which for many decades had a more open admissions policy to one which is consistently increasing its admissions standards to attract better qualified students present unique challenges when trying to maintain a diverse student body.

The academic preparation of inner city students is generally not as sufficient for college study as those coming from suburban communities which are more affluent. Secondly, the academic preparation that is expected in most schools of engineering may not be accessible to students from inner cities so that they could become better prepared for acceptance into engineering programs and success in engineering majors. Students who live in urban centers are generally those coming from households with lower incomes and a family structure where a single parent (normally the mother) runs the homestead. These students are also disadvantaged because their school system does not prepare them well for college, especially for the rigors of an undergraduate engineering education. In New York City as with most urban centers within the United States, disadvantaged is usually equated to under-represented minorities since large populations of minorities usually live in inner cities.

Joint/Dual Degree Partnership Vision

Grove's joint/dual degree programs enroll students who would normally not be able to enter into its school at the freshman level. Some students who may have experienced serious challenges in the engineering curriculum if they entered City College as freshman students would also take this pathway to the engineering degree. These include students who are unable to attend City College because of financial reasons; tuition at the community college is cheaper than the tuition at City College. In addition, the courses at community colleges are generally scheduled around the lifestyle of a working adult and this allows the student, to save some money that he or she would normally spend for tuition, but it would also give the student the opportunity to work which would assist him or her in securing additional finances that may not be possible if he or she is attending City College. The student gets the opportunity to engage in an engineering community where they can interact with students who are part of engineering student organizations as well as STEM faculty and researchers. In addition to the comprehensive support services for which they can avail themselves on the community college campus, some students also take advantage of the tutorial services that are available at City College.

Institutional Profiles

The City College of New York is a senior college within the City University of New York system. The Grove School of Engineering is an ABET-accredited school within The City College of New York. Hostos Community College and LaGuardia Community College are both community college that are part of the CUNY educational system. Hostos Community College is located in the 16th Congressional District (one of the poorest in the United States). LaGuardia

Community College also serves many students from diverse backgrounds especially new immigrants to the United States. The City College of New York is an integral part of the Harlem community in New York City. Our 2-year institutions grant Associate's Degrees while The City

College grants bachelor's, master's and doctoral degrees in engineering. All of the institutions comprise of a large number of students from under-represented backgrounds. At Hostos Community College, almost 90 percent of the student population is from Hispanic and Black backgrounds. Approximately 80% of students at Hostos Community College come from households with an annual income of less than $30,000. Additionally, over 85% of Hostos' students needed one or more remedial/developmental course in reading, writing and/or math mainly because of the lack of adequate preparation in high school or because they were English as a Second Language learners.

Table 1. Performance of 1st time freshman students at Hostos Community College on the CUNY Skills Test (Fall 2007).

	% of Freshmen Requiring Developmental Courses
English as a Second Language Developmental Course	18.00%
English Developmental Course	44.50%
Math Developmental Course	61.10%

The entrance examinations in mathematics, reading and writing that are administered to all CUNY students are used to evaluate the readiness of students for college-level work. The community colleges still have a remedial education component that permits students who are not sufficiently prepared for college to enter into their degree programs. In the recent past, City College has been increasing its admissions standards and students who do not pass the basic criteria in mathematics, reading, and writing for entrance into the college are not granted admissions. The admissions criteria for the Grove School of Engineering are tending towards a more selective framework that will consider diversity when accepting freshman students into its future freshman classes. The Grove School will utilize a supplemental application process which includes the use of recommendations and a personal statement for selecting freshman into its Fall 2009 class.

Students who are accepted into the joint/dual degree programs at the community colleges are those who would not have gained entry as freshmen into City College's engineering programs. The City College of New York's mission is "access and excellence". Two-year college-bound students also tend to select schools that are located in the communities where they live and/or work. Students whose families are recent immigrants to the United States as well as those who are first-generation college students may opt to attend a community college. Pursuing a community college education can provide the necessary support structures that will facilitate a smoother matriculation of these students than attending a four-year college where more is expected of them.

Articulation versus Joint/Dual Degree Partnerships

Many community colleges throughout the country have articulation agreements with senior colleges and universities, but the joint/dual degree programs in The Grove School of Engineering at The City College of New York make articulation only the basis of a much larger framework of targeted relationships that works towards the realization of common goals especially the provision of a dynamic undergraduate engineering education for a diverse student population (Tobolowsky 1998). All courses that are part of the formal contract are aligned to their equivalent courses at The City College of New York. They generally constitute the first two years of the respective engineering curriculum at The City College. Graduates of our joint/dual degree programs receive transfer credits for all courses that they take as part of the program while they are enrolled at the community college (Walser and Karim 2004). Even though City College normally only grants transfer credits for courses with a certain minimum grade, joint/dual degree program graduates are granted credits for all courses which are part of the program once they have earned at least the minimum passing grade that is required of students at The Grove School for the particular course. Students who did not graduate from the program as well as those who were not part of the program, but who took the same course at the community college, are only granted transfer credits on a course-by-course basis. The courses that constitute the contract are therefore granted transfer credits because of the joint/dual degree agreement. Even though the community college partner aligns their courses to match the content, credit hours, laboratory component, skills set, and software/applications package specifications that are similar to the learning outcomes for the City College's equivalent courses, there may be changes that occur on the City College's end which would deem any course non-transferable at the discretion of the department in which the course resides at City College. However, the transfer credit guarantee that is in the contract allows joint/dual degree students the peace of mind to know that their credits will be transferred to City College. It should be noted that once there are changes that have been ratified by the curriculum committee and faculty at the Grove School of Engineering, this information is shared in a timely fashion with the affected community college partner to allow for the necessary adjustments in the courses at the community college and/or the necessary substitution of courses if there is a change in the courses that are required for the first 2 years of the Bachelor of Engineering (B.E.) curriculum.

Partnership Models

The Hostos-Grove Partnership Model provides joint/dual degree program students at Hostos Community College with the opportunity to enroll in engineering courses at The Grove School as an integral component to completing their Associate Degree (AS) in Engineering. The engineering majors at Hostos Community College are Chemical Engineering, Civil Engineering, Electrical Engineering, and Mechanical Engineering. The LaGuardia-Grove Partnership Model entails the completion of an Associate of Science Degree in the disciplines of Civil Engineering, Electrical Engineering and Mechanical Engineering before the student transitions to The Grove School of Engineering for the final two years of his or her baccalaureate education.

Challenges

One major challenge is the recruitment of more female students to pursue the joint/dual degree program. At both institutions, the number of males in the program is more than the number of females. On a national perspective, 17.90% of students enrolled in engineering majors at the undergraduate level are female (ASEE 2009). However, only 5.21% of joint/dual degree program students who are enrolled/have been enrolled at City College's Grove School of Engineering are female. Even though these students contribute to the percentage of female engineering students at the Grove School (16.36% of Grove's undergraduate student population are female), more outreach has to be done to recruit and retain female students in the program.

All joint/dual degree college partners are part of the larger entity, The City University of New York (CUNY). Dual enrollment of students who are attending one of the community colleges and their concurrent matriculated status at The City College of New York is still being discussed. Even though joint/dual degree students are considered students at City College, they are not in the CUNY-wide system as meeting this designation. Therefore, early advisement/registration opportunities that exist for matriculated students at City College, do not translate into the exact same privilege for joint/dual degree program students; they have to undertake an e-permit process before being able to take courses at City College. This e-permit process has different layers of approval and it is a system which opens for a fixed timeframe (usually after the start of registration for City College's students). The enrollment capacities of engineering baccalaureate degree programs at City College are limited since students who are currently matriculated at the college are filling most of the available spaces in many engineering courses. As such, joint/dual degree program students are competing for limited spaces in engineering courses and this may affect their ability to graduate from the community college partner institution. There is no reservation of spaces in most of these courses for joint/dual degree students because of the demand for them by current matriculated students at City College. Also, procedures and deadlines are stipulated by CUNY for students who are transferring from one college into another, and therefore, joint/dual degree program students do not really transition to The Grove School of Engineering component after the completion of their associate degree, as smoothly as they should be able to.

The relationships that exist between key enrollment management offices at partner institutions and with similar entities at City College support an infrastructure that goes well beyond the framework of normal enrollment management functioning for these students. Staff from all institutions work together to facilitate the smooth transitioning of students between campuses when they take engineering courses on e-permit as well as when they are making the transition from the community college to the Grove School of Engineering for the final two years of their undergraduate education. Coordinated communication sessions such as meetings between frontline personnel and administrators on a periodic basis provides the initial impetus for regular dialogue between stakeholders. The formal institutional infrastructure that evolves using the initial contract as its basis, periodic discussions between parties at the executive level, the inherent value-added character that is synonymous of CUNY staff and administrators with particular reference to support of the mission of joint/dual endeavors, and the university's culture

that promotes access and excellence for a diversity of students, all contribute to making these partnership programs, more successful.

Defining Success in the Landscape of Diversity

Since this program is a relatively new initiative, success is being relatively measured, qualitatively and quantitatively. The collegial partnerships that have been developed and strengthened since the inception of the joint/dual degree programs have led to improved service for the students whom we serve (Morphew, Twombly and Wolf-Wendel 2001). The allocation of resources including staff dedicated to the realization of program objectives indicates institutional commitment on the individual campus level as well as on the City University of New York stratum. These programs are important as a direct pipeline to engineering majors for disadvantaged students since it continues the university's strong tradition of preparing engineers from diverse backgrounds.

Some critics may argue that the number of students who transition to Phase II (transferred to City College upon completion of the Associate Degree from the community college partner) of the joint/dual degree engineering program is relatively low. However, besides the program being relatively novel, there is no claim that most of the students will make it through the program, even at the community college end, since engineering as an academic major is very rigorous. Many of the students who initially start the program at the community college are unaware of what it takes to succeed in the major as well as what the career entails and what is expected of the engineering professional. Besides being a pipeline that facilitates the continuation of their education towards a bachelor's degree in engineering, this program exposes students to the world of engineering; it sparks their curiosity, prepares them academically, supports them personally, and guides them accordingly. The selection of a career pathway is one of the most important decisions in the life of a person. In professional fields, this is compounded by the early decision to pursue a course of studies that require a very specialized curriculum. The early exposure to the field especially with reference to the discipline, motivation, and diligence that are required to excel in the major, helps the student to make the decision whether engineering is really the best choice for him or her. The program is not geared towards scaring students out of a particular major, but it provides students with a realistic approach to grappling with engineering as a major/career by helping students understand the expectations of the major. With the comprehensive support services that are present on the community college campuses especially with reference to academic, personal and career development, the program, through its academic course offerings, educational support, career mentoring, and enrichment activities, aim to be a better program by increasing the number of graduates of these programs who transfer into the bachelor's degree program at The Grove School. Some graduates will choose to pursue STEM majors at other institutions upon graduation. It is equally as important that joint/dual degree students obtain a real life perspective about the engineering major while they are in the community college segment of their education since this will assist them in making the choice on whether engineering is the right career pathway for them. There may be some students who will be doing well in the major who would choose another academic major to pursue or who may have to leave school to support their families; these are circumstances that are faced by our community college students. With the support structure that is in place at the community college, the program will try to ensure that all students are provided with the proper guidance and support

by the college as they explore their options. For those students who continue to be challenged academically by the rigors of the academic major, the program provides inter-session preparatory courses, and supplemental academic support services such as tutoring and academic counseling to maximize these students' chances of success. In some instances, financial assistance is made available to students in the program so that they could continue their studies.

Those joint/dual degree students who graduated from the community college partner were prepared enough to persist towards their baccalaureate degree at City College even though their grade point averages were not sustained at the same standards that they achieve at their respective community college (Adelman 2005). However, those who transferred from Hostos Community College were definitely better prepared at the end of their Hostos Community College education as compared to those who were taking e-permits while being enrolled at Hostos Community College, as is reflected by the much lower grade point average that they earned at City College as compared to those who completed the program and transferred to City College.

Table 2. GPA distribution for all dual degree students who have registered/are registered for City College courses (Fall 2009).

CLASSIFICATION	**Average GPA At Community College**	**Average GPA at City College**
Phase I: Epermits (Hostos Community College)	3.16	2.09
Phase II: Transfers (from Hostos Community College)	3.31	2.61
Phase II: Transfers (from LaGuardia Community College)	3.12	2.69

It should be noted that those joint/dual degree students who transferred to The Grove School for Phase II of their baccalaureate education (the final 2 years of their bachelor's degree in engineering) had a combined persistence rate of 83.33% (for both LaGuardia Community College and Hostos Community College).

Conclusion

The partnerships that have been established between the community college units at The City University of New York and its senior college, The Grove School of Engineering at The City College of New York does shift the paradigm of who enters into engineering majors and who excels in engineering majors. Even though these programs are relatively new, the partnerships which are being cultivated and strengthened between a myriad of stakeholders at the university continues to lead to the common goal of providing access to the excellence which is an engineering baccalaureate education, especially for under-represented minority students who make up only 14% of undergraduate engineering enrollment in the United States while at The Grove School, they constitute over 40% of its undergraduate engineering population (ASEE 2009). These collaborations would only make these programs much stronger. As staff changes in particular programs, the continuity of programs falter since commitment can sometimes be driven by individual passion. However, the formal articulation agreement that established these partnerships as initiated by visionary scholars is constantly being re-visited in its living document form so that institutional commitment is constant with a dynamic infrastructure is alive.

Bibliographic References

Adelman, C. 2005. Moving Into Town and Moving On: The Community College in the Lives of Traditional–aged Students. Washington, D.C.: U.S. Department of Education.

ASEE. 2009. Profiles of Engineering and Engineering Technology Colleges. Washington, D.C.: American Society of Engineering Education.

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

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

Tobolowsky, B. 1998. Improving Transfer and Articulation Policies. ERIC Digest (ED416934), 1998. Website URL [http://www.ericfacility.net/databases/ERIC].