Establishing Pathways to the Professoriate for Underrepresented Minority Students

Dr. Audeen W. Fentiman, Purdue University, West Lafayette (College of Engineering)

Audeen Fentiman is Associate Dean of Engineering for Graduate Education and Interdisciplinary Programs and the Crowley Family Professor in Engineering Education at Purdue University.

Dr. Janet M. Beagle, Purdue University College of Engineering

Dr. Janet Beagle is the Director of Graduate Programs for Purdue University’s College of Engineering. Formerly the Director of Graduate Admissions over five campuses and more than 100 graduate programs, she has worked with graduate recruitment and admissions for more than 10 years. One of her key roles is to support students as they learn about and apply for graduate study. She has traveled internationally and presented to students on three continents on preparing for graduate school.

Dr. Phillip S. Dunston, Purdue University, West Lafayette (College of Engineering)

Phillip S. Dunston is a Professor in the Lyles School of Civil Engineering at Purdue University in West Lafayette, Indiana, where he also holds a joint appointment in the Division of Construction Engineering and Management. He obtained his doctorate from North Carolina State University and served on the Civil and Environmental Engineering faculty at the University of Washington prior to joining the faculty at Purdue.

Ms. Susan K. Fisher, Purdue University, West Lafayette (College of Engineering)
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Introduction

A grant from the Provost’s Office at Purdue University is supporting a program to establish pathways to the professoriate for underrepresented minority (URM) engineering students from minority serving institutions (MSIs). The program is managed by faculty and staff affiliated with graduate engineering programs at Purdue. Components of the program include (1) opportunities for research collaboration between faculty at Purdue and MSIs, (2) a summer undergraduate research program at Purdue for rising senior MSI students, followed by co-mentoring by MSI and Purdue faculty during the senior year, and (3) a summer bridge program for some MSI graduates who are admitted to graduate programs in engineering at Purdue.

In the first year of the program, progress on the three components has been significant. Eight faculty members from MSIs have visited Purdue, and Purdue faculty members have visited four MSIs with the goal of all visits being to give seminars and explore opportunities to collaborate on research. Nine students participated in the summer undergraduate research program at Purdue and provided feedback on the program. In an effort to make the bridge program in the coming year as effective as possible, the project team interviewed current engineering graduate students at Purdue whose undergraduate degree is from an MSI or other relatively small school, to learn what challenges they faced when making the transition from a small, minority-serving institution to a large, majority institution.

During conversations with faculty members at MSIs and with URM students participating in the first year of the summer undergraduate research program, it became clear that the end of the junior year was too late to introduce students to the idea of pursuing a graduate degree and faculty career in engineering. By that time, most of the top students had already participated in corporate internships or had been approached by employers and were planning to start a career immediately after finishing the bachelor’s degree. As a result, the project team decided to add a new component of the program. The new component was called Early Pathways and was designed for sophomores from the MSIs and their faculty or staff mentors.

The remaining sections of this paper outline the motivation for this program, describe the program itself, and report on student reaction to the first year of the Pathways program. In addition, the new Early Pathways component planned for the spring of 2017 will be described.

Motivation

The overarching goal of the project is to increase the number of underrepresented minority students who pursue a Ph.D. and a faculty career in engineering. The motivation for this project is straightforward. By 2044, the majority of Americans is projected to be non-Caucasian.¹ The percentage of URM students completing engineering degrees is currently far lower than the percentage of URM students in the population.² Engineering is a field that has historically contributed to improving both the nation’s competitiveness in global markets and the quality of life for its citizens. To remain competitive, the United States cannot afford to have a large portion of its
population either uninterested in pursuing or unprepared to pursue engineering degrees. Employers across the nation are clamoring for more engineers from underrepresented groups, noting that in order to design and manufacture products that appeal to a broad segment of the population and simply to get the diverse set of perspectives necessary to produce the best designs, they need diverse engineering teams.

One of the most important factors in recruiting, retaining, and graduating URM engineering students at all levels is a diverse faculty. As the number of faculty members from underrepresented groups at an institution increases, the culture of the institution begins to change, becoming more likely to help students from underrepresented groups feel welcome. It is particularly important that a land-grant university, which has a responsibility for educating “a broad segment of the population with a practical education that had direct relevance to their daily lives,” be prepared to educate a diverse group of students with preparation for and an interest in engineering. Seeking more underrepresented minority faculty members helps the land-grant university fulfill its mission.

In view of the need for more underrepresented minority faculty members, the project team proposed a program designed to attract more URM students to graduate school in engineering with an ultimate goal of pursuing a faculty career. Several studies have shown that participation in undergraduate research is often the activity that leads a student to seek a graduate degree. Thus, an undergraduate research component was incorporated into the program. It is often the student’s undergraduate research mentor who persuades him or her to pursue a graduate degree. In other cases, it is a faculty member teaching an undergraduate class who first recognizes a student’s potential for graduate work. As a result, the project provided funding for faculty members from MSIs and Purdue to visit each other’s institutions and explore opportunities for collaborative research projects that would involve URM MSI students. Such collaborative projects would allow URM students from the MSIs to have research experience and mentoring at both institutions.

Many other factors that influence a student’s decision about whether to attend graduate school had to be addressed in the program. The first is how to pay for graduate school. Undergraduates often do not know their options for paying for graduate school. Many URM students at MSIs are first generation and come from families of limited means. Graduate school appears to be a luxury they cannot afford, especially when a job in industry immediately after graduating with a bachelor’s degree offers excellent pay. A second consideration is location. Faculty and staff at MSIs often told project team members that students at their institutions tend to be from the local area and have a very strong support network of family and friends. The graduate program would need to provide a reliable support network. A third factor in any decision to attend graduate school is the match between the student and the program to which he or she applies. No one institution can offer a good fit for every student. The project team decided early on that its goal must be to encourage each student in the program to pursue a graduate degree at the institution, or series of institutions, that best meets the student’s needs. Sometimes that would lead the student to a program at Purdue, and sometimes it would not.

Recruiting a student into graduate school is only the first step. Retaining the student through the Ph.D. is also essential. Finding a graduate program that is a good fit and creating a supportive
network will help with retention, but making a smooth transition from an undergraduate program to graduate studies is important too. The program would need to include a bridge program for students who chose to attend Purdue.

Finally, to meet the goals of the program, the students must do more than just complete a Ph.D. in engineering. They must also pursue a faculty career. Students who have attended a primarily undergraduate institution have known many faculty members who focus almost entirely on teaching and mentoring students. Students from those institutions often speak very highly of their faculty mentors and want to be like them. However, several engineering graduate students have told project team members that they are not interested in the sometimes all-consuming, apparently high-stress jobs their mentors have. Thus the program would have to include ways to make students aware of the many positive aspects of a faculty career and encourage them to consider such a career.

**Description of the Pathways Program**

Design of the Pathways to the Professoriate program began with the selection of 25 MSIs as participants. They consisted of 14 HBCUs that belong to AMIE (Advancing Minorities’ Interest in Engineering), a consortium of HBCUs with ABET accredited engineering programs and organizations that employ their graduates, and 11 Hispanic Serving Institutions (HSIs) that had a connection to Purdue. Connections included faculty members at the HSI that held a degree from Purdue, or vice-versa, existing research collaborations involving faculty from both institutions, and graduates from the HSI already attending graduate school at Purdue.

To strengthen the connections between the MSIs and Purdue, the program provides funding for 12 faculty members from MSIs to visit Purdue to present a research seminar. During the visit, the MSI faculty member also meets with current or potential collaborators and talks with the Pathways team members. Funding is also provided for up to 12 Purdue faculty members to visit MSIs to give a research seminar, meet with potential collaborators, and talk with students about undergraduate research, graduate school (including paying for it), and faculty careers. The project team has prepared materials on all of those topics, except the research seminar, that the Purdue faculty members are welcome to use or modify as they choose.

An existing Summer Undergraduate Research Fellowship (SURF) program at Purdue reserves 10 slots for Pathways students and is a centerpiece of the Pathways program. Rising seniors at the MSIs who have interest in and potential for completing a Ph.D. in engineering and pursuing a faculty career are encouraged to apply to SURF through the Pathways program. Announcements about SURF and the Pathways program are distributed at the MSIs by faculty or staff members who are collaborating with Purdue faculty or the Pathways staff. SURF/Pathways participants are selected on the basis of their interest in and preparation for graduate studies in engineering and on the availability of a Purdue faculty mentor with a research program in the area of interest to the student.

MSI students selected for participation in the summer undergraduate research program at Purdue receive a stipend, paid housing, and up to $500 for travel expenses. Each participant is matched with a Purdue faculty member who will mentor the student and guide his or her research during
the summer. The student is typically integrated into the faculty member’s research group and has an opportunity to work with graduate students and postdocs. Like all participants in SURF, Pathways students attend several informational and professional development workshops on topics such as applying for graduate school, applying for fellowships, and making effective presentations on their research. In addition, Pathways participants have an opportunity to talk with faculty members about faculty careers, meet regularly with current URM graduate students, and talk with Pathways team members about topics of particular interest to the participants.

During the summer, Pathways team members make sure that a connection is established between the Purdue mentor and the MSI mentor for each participating student. Over the course of the student’s senior year, these mentors are both available to talk with the student about research, graduate school, applications to graduate school and fellowship programs, faculty careers, and other professional development topics.

The bridge program, which will be available in the summer of 2017, is designed for URM students from MSIs who have accepted admission to an engineering graduate program at Purdue in fall 2017. Current engineering graduate students at Purdue provided some insights into the challenges faced by students making the transition from an MSI to Purdue. They included faster paced courses, a different type of faculty-student relationship, and difficulties in getting to know people from cultures much different from the student’s. The bridge program is expected to help students address those challenges. As a participant in the bridge program, the student will begin working with his or her advisor’s research team during the summer and become integrated into the team and acclimated to the campus before the rush of fall semester begins. The bridge program is flexible in that a student can either work on research for a stipend or be enrolled in the university during the summer and take a math or engineering course while beginning his or her research project. The Pathways program pays about half of the cost of the bridge program with the faculty member or engineering department bearing the rest of the cost.

Assessment of the effectiveness of the Pathways program is straightforward. The project team will follow the student participants to determine how many apply to graduate school in engineering, are accepted, enroll, complete a Ph.D. and pursue a faculty career. This is a long-term project whose impact will be felt only if it is sustained over many years. Faculty and students participating in the program will be interviewed periodically to learn what can be done to improve the program. The first group of student participants was interviewed near the end of their summer undergraduate research experience in 2016. Their comments are reported in the next section.

**Student Reaction to the Pathways Program**

During the summer of 2016, nine students participated in the summer Pathways program at Purdue. Near the end of the summer, Pathways team members met with five of the students who volunteered to participate in a focus group and asked questions about what was most valuable to them as well as questions related to improving the program for the next group of participants. Three of the students had participated in research programs before, and two had not.
Why did the students decide to participate in Pathways? Faculty played a critical role in encouraging students to attend the summer research program. Students indicated that professors at their home institutions and professors they met while visiting other universities encouraged them to learn more about summer research experiences.

What were the most attractive aspects of the summer research program? Three main themes emerged. First, the ability to choose from a variety of research topics and then engage deeply with the chosen topic was viewed positively. Even those students who had participated in research before said that the intensity of this program allowed them to experience what it was like to conduct research full time. They characterized it as an “internship as a graduate student”, and indicated that while many students have internships in industry and learn about a career there, very few have an opportunity to see, first hand, what it would be like to be a graduate student. Four of the five were convinced they preferred the graduate school route. The fifth student was still thinking about it. Participants also enjoyed being able to explore related engineering disciplines that, in some cases, were not taught at their home institutions. They said the opportunity to give a poster presentation and have the possibility of being included as an author on a research paper was enticing.

A second attractive aspect was the opportunity to network with faculty, graduate students, and other participants in the Pathways program. Through their connections with graduate students, participants learned that research doesn’t always go the way you expect it to, but that if you are persistent, flexible, and patient, you can successfully complete a project. They learned the value of talking with other researchers who can provide insights that help you get through difficulties in your research. One of the students noted that he really enjoyed the diversity of the graduate student body. He had not previously met students from Asia and was excited to learn about their culture, food, games, and so on.

The third attractive aspect of the program was the money. Students liked being paid to participate.

Students also provided some suggestions for improving the program. They liked the lunch meetings with other participants but felt that most days they were in their research labs all day and had little opportunity to stay connected to other students in the Pathways program or in SURF. They wanted more opportunities to talk with their friends about their work. While students received information on local attractions and were encouraged to make time to see them, they commented that they rarely were able to do so. The research demanded too much time. They suggested that visits to those attractions be organized. One other common comment was that the faculty mentors’ expectations were too high. Students felt they worked very hard to complete the work in the time available and felt stressed much of the time. By the end of the summer, they were typically proud of their results, but early on they often floundered. They suggested that the project team tell the participants this will happen so they know to expect it.

**Early Pathways**

Since the beginning of the Pathways program, the project team has heard from MSI faculty members and students alike that the summer following the junior year is too late to begin talking
with students about graduate school and a faculty career. By that time, many top students have already decided to pursue a career in industry. In response, the team has designed a companion program entitled Early Pathways. While a research experience for younger students would be ideal, budget constraints would not allow it. Thus the team opted for a different type of experience for younger URM students from MSIs. This section describes the Early Pathways program which is scheduled for late March 2017.

Early Pathways is for sophomore URM students at MSIs and their mentors. The program is advertised using the network that was established in the Pathways program. MSI faculty or staff members are invited to nominate two to four sophomores, who appear to have the talent and temperament to pursue a Ph.D. in engineering and a faculty career, for participation in the Early Pathways program. Space in the program is limited, and unfortunately not all of the nominees can be accommodated. Once student participants are selected, the students and the faculty or staff member who nominated them are invited to the Purdue campus for the two-day Early Pathways program.

For part of the two-day visit, the students and faculty or staff members will be together. Other times, students and the faculty or staff members will part company. Students and adults together will attend sessions discussing the value of a graduate degree, what experiences and accomplishments tend to make a student a more competitive applicant for graduate school, options for paying for graduate school, and what undergraduates can do to make themselves more competitive for fellowships, scholarships, and assistantships. While students tour laboratories, participate in some hands-on activities, and hear about some of the research projects faculty and graduate students are conducting to help address important technical issues, MSI faculty and staff members will meet with their counterparts to discuss common interests and explore opportunities for collaboration. Opportunities will be provided for faculty members from both the MSIs and Purdue to talk with participating students about faculty careers.

Project team members will stay in touch with the MSI students, faculty, and staff who participate in the Early Pathways program and agree to additional conversations. The goals will be to track the students’ academic careers and identify opportunities for long-term collaborations between faculty and staff members at the MSIs and Purdue.

Concluding Remarks

Based on information in the literature and conversations with faculty members from MSIs, a team of faculty and staff affiliated with graduate programs in engineering at Purdue proposed a project to encourage URM students from MSIs to pursue graduate education and a faculty career in engineering. The program, entitled Pathways to the Professoriate, began in 2016 with faculty members from MSIs and Purdue visiting each others’ campuses and nine MSI rising seniors participating in a summer undergraduate research program at Purdue. Those students had a positive experience, and most want to pursue a graduate degree. The information they provided in a focus group discussion will help the project team improve the summer research experience next year. Meanwhile, it became clear that the summer following the junior year was too late to begin talking with students about graduate school and how to prepare for it. The project team
responded by designing an Early Pathways program that will be launched in late March for sophomores from MSIs and their mentors.

References