

2006-2440: MOVING HIGH-PERFORMANCE URM STUDENTS INTO THE PROFESSORiate: THE NMSU AMP BRIDGE TO THE DOCTORATE PROGRAM

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Moving High-Performing URM Students into the Professoriate: The NMSU AMP Bridge to the Doctorate Program

The nationwide dearth of women and minorities in the professoriate has been the focus of much attention in recent years. The National Science Foundation, for example, has implemented a series of programs that seek to increase these under represented groups' participation in the professoriate, including: the Alliance for Graduate Education and the Professoriate (AGEP: under represented minorities), ADVANCE: Institutional Transformation (women), and most recently the Alliance for Minority Participation (AMP) Bridge to the Doctorate Program (under represented minorities). The latter program builds upon the successful nationwide Louis Stokes AMP programs by encouraging retention of high-performing minority students after completion of their undergraduate degrees to "bridge" them into doctoral programs. Unlike AGEP, the AMP Bridge to the Doctorate Program (hereafter, simply the Bridge Program) emphasizes success at the masters level and while preparation as future faculty members is stressed, it is not the principal program goal.

The Alliance for Minority Participation Bridge to the Doctorate Program at New Mexico State University (NMSU) recruited 11 under represented minority (URM) students into masters programs in engineering in 2003 with the intent of moving these students onto doctoral programs at the completion of the masters degree. Each student was paired with a mentor, received a generous stipend to fully support their graduate education, and participated in a special seminar on preparing for doctoral study conducted by one of the co-authors, the Program Director.

Two additional cohorts have been recruited. The second cohort includes 13 students, of whom four are engineers, while the third cohort has 10 engineering students and two students from non-engineering fields. Students from cohorts two and three were recruited more recently and, therefore, are newer to their graduate programs. This paper will focus on students from the first cohort, many of whom have already completed masters degrees.

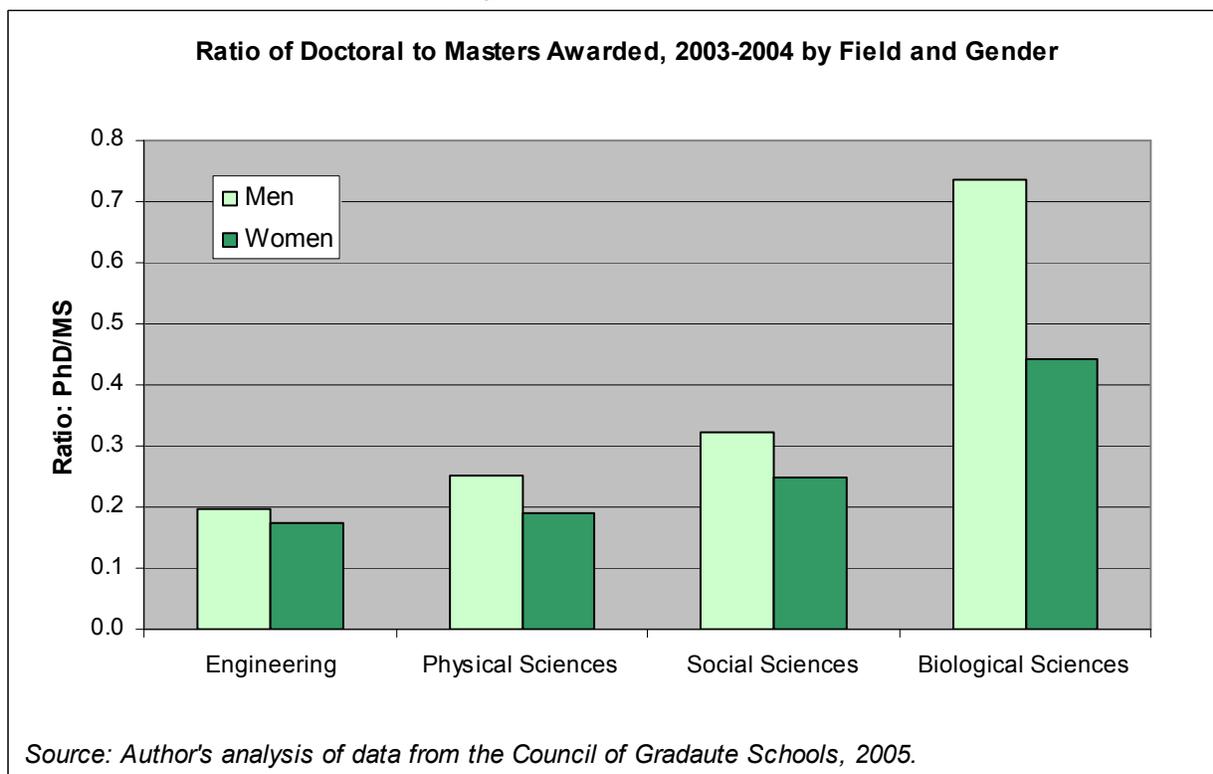
In this paper, we discuss findings from a qualitative evaluation using multiple methods of inquiry. In-depth interviews with students within their first year of graduate school, exit focus group interviews and a brief survey of students, interviews with advisors at the start and end of the students' graduate program and students' own documents—specifically, the essays that they wrote to enter the program in comparison to doctoral program application essays—provide us with rich information about each of the students in the program. Using a case-study approach we discuss the efficacy of the various program elements relevant to students' success in graduate school and make recommendations about avoiding potential program pitfalls. Our research also sheds light on the unique cultural experiences that can make pursuing graduate education particularly burdensome for minority students and how institutions can respond to these challenges to ensure minority students' success.

NMSU's LSAMP Bridge to the Doctorate Program

Initiated in 2003, the NMSU Bridge to the Doctorate Program represented an extension of the highly-successful LSAMP program further along the educational pipeline. Previously, AMP

efforts had focused on transitions between high school and college and between 2-year and 4-year institutions to recruit and retain talented under represented minority (URM) students in science, technology, engineering and mathematics (STEM) fields. The Bridge program sought to move high-performing graduates of AMP programs into masters programs with the ultimate goal of supporting these students to transition to PhD programs.

Figure 1. Ratio of PhDs to Masters Degrees Awarded in STEM Fields, 2003-2004 Academic Year, by Field and Gender



The transition from the masters to the doctoral degree is far from assured for students in engineering. At the national level, using cross-sectional data on degrees awarded at the masters and doctoral levels, Figure 1¹ shows that this ratio is smallest in engineering as compared to other STEM fields. The ratio for men was 0.20 while for women only 0.17—which can be roughly interpreted to mean that less than one in five of all engineering masters degree recipients move along to earn a doctoral degree in engineering.

Students in engineering fields are, therefore, ideally suited for the structure of the Bridge to the Doctorate Program. The program provides a generous stipend for two years' of graduate work so that students can pursue research projects rather than doing other kinds of work to support themselves in graduate school. The program is less-well-suited to students in those science disciplines in which it is not normative to complete a masters degree prior to a PhD. That is, in

¹ This analysis is a very crude indicator of the likelihood that students move from masters to doctoral programs. A more accurate method would use longitudinal data on masters degree recipients' career paths, which are not currently available at the national level and seldom exist at the institutional level.

fields like chemistry, physics, and biology, for example, most graduate students enter PhD programs directly rather than first earning masters degrees.

Figure 2. Ratio of PhDs to Masters Degrees Awarded in Engineering Fields, 2003-2004 Academic Year, by Field and Gender

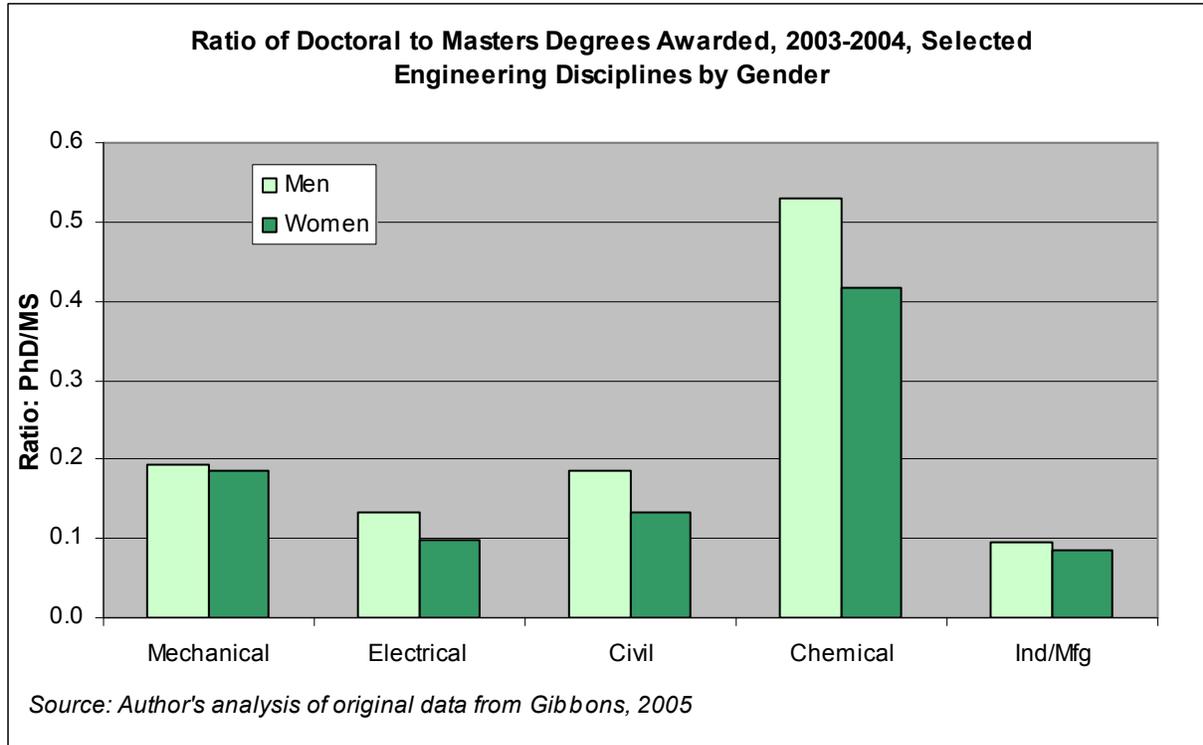


Figure 2 presents a “crude” analysis similar to that shown in Figure 1. Here, data from Gibbons (2005) for the relevant ratios of PhD to masters degrees for the five engineering disciplines with doctoral programs at NMSU are shown. Figure 2 shows that within engineering disciplines there are variations in the likelihood of students eventually earning PhD degrees with a proportionately higher number of PhDs in chemical engineering and far lower proportion of PhDs to masters in industrial and manufacturing engineering. Likewise the ratios differ by gender with generally higher ratios for men than for women within the same field.

As previously indicated, the first cohort of students recruited to the Bridge program in the 2003-2004 academic year were all in engineering disciplines. In engineering at NMSU it is customary for students to first earn a masters degree and then to continue on with a doctoral program at NMSU or elsewhere, or, most commonly, to secure a well-paying job in the state’s high-tech industries.

NMSU is the public land-grant institution in the state of New Mexico. While the state has rich cultural diversity, the New Mexico has long struggled with high poverty rates and a weak economic base. About half of the undergraduate engineering students at NMSU are from URM groups: in Fall 2005, 46% were Hispanic, 2% African American and 4% American Indian (NMSU 2005). Finally, NMSU’s College of Engineering has the fifth highest number of

Hispanic faculty members (11) among U.S. engineering and engineering technology schools (Gibbons 2005).

The four graduate programs in which the Bridge Program students majored differ in terms of size of faculty, degrees awarded, and graduate enrollment. Table 1 indicates that the electrical engineering program has more students than the other three programs combined but not substantially more faculty members. The graduate student to faculty ratio was lowest in mechanical engineering but was around 3:1 for all but electrical engineering in which the average tenured or tenure track faculty member was likely to be responsible for supervising nine students and industrial engineering with an average of 12.6 students per faculty member. Concurrently, productivity in terms of degree production per faculty member was highest in industrial engineering with 5.8 degrees per faculty member and then in electrical engineering with an average of 2.6 graduate degrees per faculty member in 2004.

Table 1. Engineering Graduate Program Departments at NMSU

	Cohort 1 Bridge Students	Graduate Enrollment 2005	Number MS 2004	Number PhD 2004	Faculty* Fall 2004	Ratios	
						Student/ Faculty	Degrees/ Faculty
Chemical	1	24	2	3	7	3.43	0.71
Civil	5	52	17	2	15	3.47	1.27
Electrical	4	184	49	3	20	9.20	2.60
Industrial	0	63	28	1	5	12.60	5.80
Mechanical	1	36	10	2	13	2.77	0.92

**Includes tenured and tenure-track faculty only.*

Given this context, the following are some key features of the participants in the first cohort of the Bridge Program:

- 9 males, 2 females,
- 10 Hispanics, 1 American Indian,
- 4 departments,
- 10 advisors (one advisor had two students; 2 female advisors, 8 males),
- Most students began in fall 2003, some started in spring 2004,
- Some students who started in spring 2004 were still undergraduates at NMSU who took advantage of taking graduate classes in their last semester as an undergraduate,
- All indicated that they wanted to earn a PhD, and
- Mean GPA: 3.6 (Minimum: 3.0, Maximum: 4.0).

Because there were so few women involved with the program, throughout this paper we largely avoid identifying individuals' gender. Likewise, because only one of the students was an American Indian, we have avoided identifying ethnicity. We have also avoided specifying individuals' departments, as further protection of confidentiality.

Program Elements

The program elements of the Bridge Program at NMSU are:

- \$25,000 participant stipend to support the student as a researcher,²
- Funds for conference trips within the student’s discipline (\$1,000/year),
- Funds for research materials and supplies (\$1,300/year),
- Tuition (up to \$3,030/year) and books (up to \$600/year),
- Paired with a faculty advisor,
- Weekly seminar series (1 hour per week),
- Conference trips as a group to the National Science Foundation, Human Resources Directorate Joint Annual Meeting (March 2004) and American Society for Engineering Education (Salt Lake City, UT, June 2004), and
- Trips to visit PhD programs at other universities.

As a program designed to provide masters-level students with a smooth transition into doctoral programs, the Bridge program provided a set of monetary supports for the student and his/her research as well as key psycho-social supports. The monetary support is utterly essential for the program. Most of NMSU’s students are considered “non-traditional” based on one—and often more than one—of the defining features of “non-traditional” students (i.e., married, presence of own children in the home, older than 22, and noncontinuous degree completion interspersed with work in the paid labor force, etc.). As such, NMSU’s undergraduate students face significant challenges in completing their undergraduate degrees in a timely manner. According to NMSU’s Office of Institutional Research and Planning, only 43% of the 2,078 members of the 1998 incoming cohort completed a bachelors degree within six years: only 12% had completed the bachelors degree in the “normal” four-year time period.

These social forces mean that when a student completes a bachelors degree, there are significant challenges to retaining the student for graduate school. The ethnic diversity of NMSU’s graduates attracts major engineering employers to campus. Their lucrative offers make it difficult for NMSU students to choose another three years of eking out a living while going to graduate school, let alone remaining an additional five or six years for a doctoral degree.

While the monetary rewards were significant in enabling students to pursue graduate studies, advisors and students alike indicated that the seminar series that provided a peer-group for the students were vital in making the program a *program* and not merely another fellowship award. Several advisors and students cited the significance of the additional travel to conferences and funds to visit other PhD programs as also making the program a more complete experience.

Additionally, many of these students had not traveled very far from New Mexico or the greater-El Paso area, therefore, the ability to visit our nation’s capitol was a rare treat and educational for this cohort on multiple levels. Formal reports completed by the students about the trip to the NSF Human Resources Directorate Joint Annual Meeting (commonly referred to as JAM), for example, emphasized that this trip gave them greater perspective on the Bridge Program and the societal need to increase the numbers of URM students receiving doctoral degrees. Panels of diverse PhDs at the JAM inspired the students to look ahead towards their own doctoral programs while helping them to understand that while they would face great challenges in these programs, the ultimate benefits were worth the hard work and dedication.

² The stipend was \$25,000 in the program’s initial year but increased to \$27,500 in the second and is now at \$30,000 per year.

The Program Director, Ricardo Jacquez, a professor of Civil Engineering at NMSU, led the weekly seminar series, which included guest speakers, discussions about professional conferences, goal setting, research and preparation of personal statements and other PhD application materials. The seminar was not merely a means by which information was conveyed to the students; rather, it also served an important function in providing a regular context in which the students could interact with each other, get questions answered that they might not be able to ask their advisors/mentors, regularly interact with the Program Director, and sometimes just “vent” about the normal frustrations associated with graduate school.

Data and Methods

Given the small number of students involved in the program, the evaluation team decided to use a qualitative evaluation design in which we would accumulate materials about the students from the start to the finish of the program and then analyze each student as a separate case study. Obviously, the draw-back of this method was that full results were not available until recently, when all of the students had completed or neared the completion of their masters program. Throughout the first two and a half years of the program, the evaluator met with program personnel on several occasions to verbally convey important feedback about the program for use in making minor modification.

The benefits of this approach are important. First, students’ confidentiality was carefully protected during their participation in the program by limiting program personnel access to certain types of data collected from the students and their advisors. Students were well aware of the program’s expectations—especially in terms of their timely completion of the masters degree and the transition to a doctoral program—and that their advisors were keys to their success. Because of the confidentiality issues, student participants were often—but not always—reluctant to say anything negative about the program, their department or their advisors until their participation in the program or their affiliation with NMSU was done.

Second, because there are so few students, any quantitative methodology was unlikely to effectively uncover key differences in the students’ experiences. Each student experienced his or her graduate program in very different ways: our task was to understand these differences and to learn if there were common themes for success and if there were ways to improve the program for subsequent students.

The case file for each student, therefore, included the following materials:

- Application to the program, which included:
 - Undergraduate academic transcripts
 - Two letters of reference
 - Personal statement.
- 2-4 evaluations of the student’s application.
- Statement of purpose written in Fall 2004 (in preparation for PhD program applications).
- Trip report on attending the NSF Human Resources Directorate Joint Annual Meeting (2004).
- Graduate academic transcripts.

- Interview transcriptions and notes for an intake interview conducted with each student (April 2004 and July 2004).
- Interview transcriptions and notes for intake interviews with student’s advisor (April 2004-July 2004).
- Notes from exit interview with student’s advisor (conducted by phone, September 2005-January 2006).
- Transcripts, notes and reports on exit focus group that involved the student (conducted in July-August 2005).
- Two-page exit survey (completed at the beginning of the focus groups, July 2005-August 2005).

In this way we were able to collect rich data about the students from multiple sources—themselves, their advisors, their peers, and documentary records—and at multiple moments in time during their masters programs. In addition, interviews of staff members associated with the Bridge Program were completed in fall 2005 to supplement these individual-level materials and provide a context to understand various issues raised by the students and their advisors. Data analysis is an on-going task, so information reported in this paper is preliminary. The researchers plan to further analyze these data using NUDIST software for a more comprehensive analysis.

Findings

Stipend

With the exception of two students, program participants—students and faculty advisors—agreed that the stipend was sufficient. Both students and advisors commented on how the stipend enabled students to focus completely on their research and classes without the burden of having to teach or serve as a grader. Some students were dissatisfied with the extent to which they were able to teach—especially since teaching was one factor motivating some students to earn a PhD—but there were no consistent opinions among the students about satisfaction with the opportunity to teach.

Did students experience any “backlash” because their stipends were so much higher than the regular stipends provided to graduate teaching and research assistants? More than half of the students indicated that they never heard non-participants express resentment about their stipends. The student who heard this sentiment often was the student that the other Bridges students felt was “wasting [their] opportunity.” When we asked advisors if they thought the stipend was too large, a small minority felt that it did not need to be so large but the remainder believed that with the other post-bachelors options available, such stipends were necessary. A cohort two advisor even argued that, perhaps, all graduate students should have access to such generous stipends to recognize the value of the work that they do and to ensure that talent is nurtured.

The biggest problem with the stipend cited by students was the lack of timeliness in students’ receipt of their funds. The stipends were processed by NMSU’s Financial Aid office, which is notorious for poor customer service and delays. The students lauded the AMP staff’s attempts to secure their funds on time, but for the first cohort it was a constant source of frustration; funds that were supposed to be available at the first of the month (when rent and other bills are often due) might not be available until the middle of the month.

A related problem associated with the stipend was the short-term nature of the funding. Students were very well supported in their MS programs but other forms of support for their doctoral programs were unlikely to match this established level of compensation. Some students suggested that the program provide more training in money management skills as part of the weekly seminar. Another option—one that is being pursued with the second cohort—is to provide the students with more training on applying for their own fellowships to pick up funding where the Bridge Program leaves off. A second-year seminar should focus on helping students and their advisors³ to craft applications for NSF’s Doctoral Fellowships program, among others. Likewise, helping students to identify IGERT opportunities, which have similar stipend levels as the Bridge Program, would be another mechanism for students to fund their doctoral programs.

The Seminar: Forging Bonds as a Cohort

As indicated earlier, students and advisors viewed the seminar as important. Students’ experiences with non-Bridge graduate students in their home departments varied substantially from those who felt they were able to interact well with others to those who suggested that the large number of international students resulted in strained relations with their peers. One student complained in an exit interview that the more highly-trained international students made classes difficult for U.S. students who had received lesser quality prior training than their international peers.

While the seminar did convey important information about the pathway to a PhD, it also provided a way for the students to meet each other on a regular basis, which was especially important for those students who felt somewhat alienated within their departments. The advisors, too, saw the merits of the seminar for precisely the same reason: their mentees would have access to a group of other URM students.

As the first cohort in the program, the seminar was a “work in progress” for the Program Director. Now, as the third cohort has started the program, the seminar has begun to “solidify.” Nonetheless, problems remain regarding the seminar that will require further “tweaking.” Students, for example, felt that there needed to be clearer punishments associated with failure to attend the seminar. Students who did attend regularly were frustrated when other students did not, since attendees also have busy schedules and other scholarly matters to attend to. As a result, students resented their peers who did not attend the seminar and suffered no consequences. Additionally, several students indicated that they sometimes felt that the material was nothing new or was repetitious but they felt obligated to attend.

For the most part, however, the seminar did provide a space for the first cohort to establish strong connections with each other. This was especially the case with one of the only two women in the cohort. While one woman was in a program where there were other female graduate students, the other was in a program with fewer women and in which there were more international students, who may harbor more traditional views about women and their role in

³ Advisors’ recommendation letters can be critical for these other fellowship programs. In examining the letters of recommendation written for the cohort 1 students, it was clear that advisors could use some training in effective letter writing.

engineering. Both the woman and her advisor reported that the Bridge cohort provided a good peer group in the absence of such a group within the woman's home department.

Mentoring

Students—with just a couple of exceptions—were generally satisfied with the mentoring that they received. In a survey, all but one student agreed with the statements: “My advisor was supportive of my desire to pursue a PhD” and “My advisor was an effective mentor to me.” The only student—in fact a student who reported very negative experiences with graduate school at NMSU more generally—who disagreed with these statements had enrolled in a major different from their undergraduate major. This student faced a number of challenges including having to take additional undergraduate courses to meet deficiencies. In addition, (s)he was not as familiar with the faculty in the department, which meant that (s)he changed advisors twice in the course of their graduate program.

In discussing the students with the advisors, it was clear that all of the advisors cared about their students. The advisors often considered themselves to be mentors, which connoted a stronger commitment in their minds than “advisor.” The advisors were well aware of personal challenges the students faced and how cultural forces might have a differential impact upon their students. As shown in Table 1 and reflected in discussions with the students, there were normative differences across departments concerning how much students were expected to be self-directed. For example, with the largest number of students, electrical engineering faculty need students to be more self-directed while faculty in departments with far lower student: faculty ratios could afford to engage in more “hand-holding.” Obviously, students who themselves prefer to be self-directed may find “hand-holding” stifling, while those who need more assistance—such as those who lack adequate preparation for a new course of study—will feel that their advisor is inadequate when they are expected to be more self-sufficient.

Mentors' assessments of the Bridge Program's level of support to them—for those with students in cohort one and/or two—differed greatly. Mentors in the Program Director's home department, for example, felt they understood the program well while those in other programs reported receiving less information. The disconnect seemed greatest with the second cohort advisors, many of whom were not in engineering, lacked prior knowledge of the AMP program, and were located far away from the AMP office. Bridge staff had difficulty contacting these faculty, some of whom were unresponsive. Discussions between the evaluation team and the Bridge staff, as well as Bridge experiences with the completion of the first cohort, have led to the development of an information packet for new mentors and the recommendation that the Program Director meet individually with all new mentors.

“Ultimate” Outcomes

The purpose of the Bridge Program was to increase the likelihood that participants would earn a masters degree and then transition to a doctoral program. To date, of the eleven members of the first cohort:

- 6 have completed masters degrees by the end of Fall 2005 with 4 of these currently in PhD programs,
- 2 are enrolled in thesis credits for Spring 2006,
- 1 will likely complete by Fall 2006,

- 2 have not registered for classes for Spring 2006 and there is no indication of graduation status.

Of the six students who completed masters degrees by Fall 2005, four students are currently in PhD programs. One other masters recipient is enlisted in the military (a commitment had been made while the student was an undergraduate- their advisor was confident that the student would return for a PhD after completing their military service). The sixth student was expected to begin a PhD program at another university, but has not been in contact with the AMP program office. The two students from the first cohort who are taking thesis credits in Spring 2006 are expected to complete their programs shortly.

One student, who chose to pursue a different graduate major than they did as an undergraduate, is continuing to take courses at the university and is expected to graduate in Fall 2006. Finally, two remaining students' masters are incomplete and their whereabouts are unknown to the program office. One of these students had been making progress on the masters thesis but was experiencing "major burnout" according to the advisor. The advisor had expected the student to complete in the spring semester. Though there is no indication that the second student completed his/her degree, (s)he is currently not taking classes nor is (s)he responding to the Program Coordinator's inquiries.

Conclusions

Communication, on many different levels, is an integral part of the Bridge Program. The Bridge Program provided advice to students about communicating with their mentors but communications between the program and mentors was less than ideal. The heterogeneity of second cohort will pose additional challenges to the Bridge program—not only because the mentors are in different fields, but also because the norms of graduate study differ greatly from those in engineering. In many of these other fields, a masters degree is viewed as a "consolation prize" for students who have been deemed incapable of pursuing a doctoral degree in a program. In general, the Bridge Program needs to understand how variations in the structure of graduate study across departments impacts faculty expectations for students (e.g., how much "hand holding" is considered appropriate, how much independence the student is expected to demonstrate, etc.).

Mentoring agreements, participation agreements, along with more clearly specified graduate programs of study crafted by the faculty advisor and the student would go far in alleviating some of the "pitfalls" that arose with the first cohort. Because the mentor is essential for a student's graduate program success, all students should be required to identify a mentor prior to the program. The Bridge Program should also verify that the desired mentor for each student is not already overburdened with students or is too "junior." Graduate students are often drawn to junior faculty who are often engaged in cutting-edge projects and work hard on research because they are on the tenure track. But these faculty can often have too many students or may be less familiar with the norms associated with graduate school at NMSU. In cases where a junior faculty member mentors a Bridge student, it would be beneficial for this relatively new faculty member to receive some mentoring from the Bridge Program Director or to be partnered with another more senior faculty member with more experience.

Students in the first cohort felt pressured to complete their degree programs in a timely manner. This pressure actually was intensified as a result of their trip to Washington DC where they attended the NSF Human Resources Directorate's JAM in 2004. At the JAM, the students learned more about the importance of the program and how as the first cohort, subsequent efforts would depend upon how well they performed. At least two students explicitly cited this added pressure in their trip reports. The project director will work with future cohorts to moderate this pressure through open discussions with the students directed at understanding the goals and objectives of the Bridge Program, emphasizing the commitment of the NSF to foster diversity of the nation's technical workforce, and guiding the students to maintain a strong focus on their goal of attaining the Ph.D. and building confidence in their abilities through successful completion of their MS program.

Interestingly, the notion that an individual serves as an exemplar of one's group is one of several well-documented pitfalls associated with being one of only a few members of a group in a social situation. Kanter's (1977) now-classic research on women in management in the early 1970s shows how the few women who were managers felt the added weight of being held up as models for all women. If they failed, then a company may not hire another woman for a long time. Kanter's work has formed the basic theoretical argument for the need for greater gender-integration in workplaces and has been extended to imply the need for greater ethnic-integration as well.

While students are expected to pursue PhD programs at NMSU or elsewhere, sources of pressure must be alleviated as best as possible. Students need to feel that the program is "on their side" and the lines of communication must remain open so students will share their post-MS plans, experiences, successes, and failures with the program staff. Such communication is essential for the long-term evaluation of programs like these.

In closing, the program evaluation is an on-going effort. The evaluation and program teams are working to maintain contact with students after they leave the program to continue to understand how to increase the likelihood that talented racial and ethnic minority students will earn doctoral degrees.

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