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Chapter 21- Mentoring Graduate Underrepresented Minorities in STEM

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21.

MENTORING GRADUATE UNDERREPRESENTED MINORITIES IN STEM

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Abstract

In this chapter, we discuss high-impact mentoring practices for graduate students in science, technology, engineering, and mathematics (STEM). We make a case for *inclusive* and assets/ strengths-based mentoring approaches as a strategy for increasing the number of doctoral degrees awarded to historically underrepresented minorities (i.e., Hispanics, African Americans, Native Americans, Alaska Natives, and Pacific Islanders); improving their levels of satisfaction with doctoral programs and reducing the notoriously extended time to the PhD that they endure. We offer two examples of national programs committed to promoting graduate student success through professional development and mentoring strategies in which instrumental support, sponsorship, psychological support, and access to funding play key roles. We also summarize relevant aspects of assessing a mentorship project and highlight the culture of an institution with sustainable mentoring practices. We conclude with recommendations and provide additional perspective on the need for scaling up the replication of evidence-based practices through effective activities such as mentorship workshops for faculty.

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Mentoring Context and Program Development

There is ample evidence that in many academic disciplines, including STEM, mentoring is at the heart of the development of students as researchers and specialists (Hensel, 2012). Historically underrepresented minority (URM) students may benefit significantly from mentoring (Committee on Underrepresented Groups, 2011), particularly at the doctoral level, where a strong and equitable relationship with their dissertation advisor is paramount for their academic progress and timely degree completion (Sowell, 2009; Clewell, 2006). Similarly, mentorship training for faculty, with significant opportunities for self-reflection on skills and issues, is essential (Hensel, 2012). Programs that emphasize inclusiveness through mentorship training may apply to all student populations, but mentoring approaches that do not challenge a priori assumptions may prove to be less effective for URM students.

Federal agencies such as the National Science Foundation (NSF) and the National Institutes of Health (NIH) promote and finance the implementation of mentoring projects through the development of Alliances for Graduate Education and the Professoriate (AGEP), the Louis Stokes Alliances for Minority Participation (LSAMP), Alliances for the Inclusion Across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (INCLUDES), and the Louis Stokes Bridges to the Doctorate (BD). Most local or regional projects funded by these national agencies involve stakeholders from one or more institutions and professional organizations that work on developing sustainable URM student mentoring projects. Examples include the University of Texas at El Paso BD (Clewell, 2006; Gorbett et al., 2020; Arciero & Knaust, 2018), the Aspire Alliance Regional Collaboratives (NSF INCLUDES, 2020; Flores et al., 2020), and the Hispanic AGEP (American Physical Society, 2021; Velez-Reyes et al., 2021), which implement formal mentoring approaches that rely on one or more strategies depending on the professional development goals of the project:

- Mentor protégé dyads and triads in which one or two graduate students are matched to a faculty mentor, typically on the basis of an academic discipline.
- Small groups of protégés that include a postdoctoral fellow and graduate students in different stages of study.
- Cohorts of graduate protégés who are mentored by a small team of faculty members and professionals.

Mentoring

At the national level, the operational definition of mentoring in NSF- and NIH-funded projects is similar to that provided by the National Academies (National Academies of Sciences, Engineering, and Medicine, 2019), which is that "mentorship is a professional, working alliance in which individuals work together over time to support the personal and professional growth, development, and success of the relational partners through the provision of career and psychosocial support" (p. 2). This definition is remarkable in that it focuses on a professional relationship and much-needed support. Yet, it does not address the dimensions of diversity, equity, and inclusion.

The activities associated with mentoring are developing and maintaining trust, providing supporting

functions and space, setting expectations, creating times for self-reflection, and pursuing a deeper understanding (education) of roles. Recent research suggests that URM STEM students not only seek to do research and develop an identity as researchers but also value professional relationships and socialinteraction with their mentors (Griffin et al., 2020). Through our work, we have found it necessary to redefine mentoring in a holistic, aspirational manner that incorporates equity, diversity, and inclusion. The mentoring projects described below subscribe to an extended, operational definition of mentoring that we developed to emphasize the need for inclusiveness:

Inclusive mentoring is a multifaceted reciprocal relationship in which a mentor engages a protégé or group of protégés from diverse backgrounds to advance their goals and to learn from their professional development experiences. In addition to guiding the discovery of intellectual passions, providing advice and access to resources, and advocating for their protégés, inclusive mentors readily acknowledge their protégés' identity, validate their backgrounds and accomplishments, and provide supportive environments to prevent isolation by promoting cultural awareness and sensitivity. Mentors and protégés work together toward a better future by engaging in a virtuous cycle of learning and growth of the individual as a whole through effective practices.

Mentoring Resources

Mentoring projects may vary in scope depending on anticipated outcomes. The following sections discuss two project exemplars funded by the National Science Foundation that are focused on graduate student development and have strong mentoring components: the Louis Stokes Bridge to the Doctorate and the West Texas Regional Collaborative. The Bridge to the Doctorate focuses mainly on preparing incoming URM PhD students to be productive in a research environment. The Regional Collaborative focuses on preparing future URM graduate students for meaningful teaching experiences at the community college level.

Throughout the duration of either project, fellows receive support that may include stipend, cost of tuition, conference travel, mentorship, and professional development, and engage in developmental activities. In particular, graduate students who participate in the Bridge to the Doctorate projects are introduced to research conducted in the institution's STEM departments and are provided workshops and training on how to manage scholarly and professional careers. Additionally, these students participate in seminar series focused on retention and success in graduate school, raising awareness of diversity issues, and preparation for future professional careers. Seminar topics include graduate school culture, diversity awareness, managing finances, final selection of research project and faculty mentor, publishing, writing, research ethics, funding, and dissertation proposals. Graduate students who participate in the Regional Collaborative project actively engage in an effective mentoring and teaching program and commit for an entire semester of internship to develop a relationship with the mentor(s) assigned. Each participant meets with their community college faculty mentor at least once monthly, documents their meetings as a reflective essay, observes at least two online (or face-to-face) classes at the regional community college, and prepares a summary of the class sessions. Participants also attend webinars throughout the semester as part of their professional development. Each webinar has a particular assignment such as composing a teaching philosophy that builds on experiences and knowledge gained through mentorship as well as developing a lesson plan based on their experience and observations throughout the semester. Together with a CV, these items become part of a fellow's

teaching portfolio. Finally, participants take a compulsory end-of-term survey for program evaluation.

Mentoring Activities

Bridges to the Doctorate

The goal of the NSF Bridge to the Doctorate (BD) projects is "to increase the quantity and quality of STEM graduate students from underrepresented populations, with emphasis on Ph.D. matriculation and completion" (Louis Stokes Midwest Research Center of Excellence, n.d.). BD projects have been implemented at 34 institutions nationwide. There are common features across all BD projects (e.g., selection processes, BD fellow support, mentor/protégé matching). The BD at one of these institutions is presented here as one example of this national effort.

Since 2003, the BD at the University of Texas at El Paso has served as host to 83 graduate students in seven BD cohorts. Each cohort is composed of 10 to 12 students from a competitive, national sample of STEM bachelor's degree recipients who have previously participated in high-impact, undergraduate educational practices offered by institutions that are partners in a Louis Stokes Alliance for Minority Participation (LSAMP). Students apply through an online process. Their applications are reviewed holistically by a selection committee consisting of faculty and professional staff who identify candidates for an interview. Following this interview, finalists are selected to participate in the project and a formal offer is made. Those who accept are welcomed to the project as BD fellows. Within a month, each cohort member is matched to a STEM faculty mentor, taking into consideration academic program requirements, affinity of research interests, and above all mutual consent. Typically, the faculty mentor is a member or director of an outstanding, productive research center or laboratory. It is expected that the faculty mentor will have extramural funding and a successful mentoring record of accomplishment.

Typically, BD projects include an evaluation process to assess BD fellow and programmatic outcomes. The evaluation process includes formative and summative assessments and is informed by program staff, stakeholders, and the evaluation team. Specifically, a logic model and various survey instruments are utilized for the evaluation of the BD. The evaluation assesses the following factors using self-reporting and objective measures: (a) assessment of traditional academic predictors (e.g., GPA); (b) skill development of BD fellows; (c) perceived culture within the labs to which BD fellows are assigned; (d) BD fellow participation of workshops; (e) BD fellow application of workshop skills; and (f) BD fellow access to peer and mentor resources; and BD fellow's perceived quality guidance from peer and mentor resources.

Regional Collaboratives

The Regional Collaborative initiative is a strategy implemented by the Aspire Alliance within the National Network of the NSF INCLUDES Alliances to diversify STEM faculty (Committee on Underrepresented Groups, 2011). To date, there are six regional collaboratives across the nation, including two in Texas. The West Texas Regional Collaborative, comprised of two universities and four community colleges, recruits graduate students from underrepresented groups to explore the possibility of a rewarding career at two-year institutions through a meaningful and intensive mentoring

relationship with STEM faculty. Since 2019, West Texas Regional Collaborative has hosted 41 graduate students in three cohorts.

The recruitment and selection process takes approximately 3 months, beginning with announcements being sent to all STEM graduate programs at participating universities with the application information and deadline, followed by a webinar for interested graduate students and faculty. A faculty panel reviews applications to build a cohort with diverse backgrounds, considering applicants' professional aspirations, teaching experiences, academic achievements, and other personal motivations. All selected applicants are accepted into our program either as full Aspire fellows or associate fellows based on ranking. Fellows are matched with faculty from two-year colleges according to their discipline. For example, an Aspire fellow who is a graduate student in chemistry is matched with a chemistry instructor at a local community college. On occasion, two fellows are assigned to one faculty member, depending on the availability of participating faculty in a particular discipline.

The purpose of these instructional, mentorship dyads or triads is to learn about effective teaching, the community college culture, and inclusive teaching practices.

At the conclusion of the semester-long program, there is a review of teaching portfolios, and students receive feedback. In addition, online surveys assess the mentoring experience for both the fellows and their mentors. Aggregate data determines the impact across regional collaboratives in the Aspire Alliance.

Mentoring Outputs

The Bridge to the Doctorate provides a research mentor for each BD fellow. The profile of the faculty mentor is that of a university professor with an active research program, substantial research resources, and a record of having trained and supported graduate students from diverse backgrounds. In addition, the BD principal investigator and co-principal investigators serve as mentors for the entire cohort of BD fellows, meeting with them weekly as a group during the semester or individually should the need arise to have private conversations. The intention is to provide research and career development-specific mentorship (i.e., with the faculty mentor) as well as program-specific mentorship (i.e., with BD PI, BD co-PIs) to support the BD fellows.

Similarly, the West Texas Regional Collaborative provides a mentor for each Aspire fellow. The profile of the mentor is that of a community college professor with ample teaching experience and a record of having coached junior faculty from diverse backgrounds. In addition, the leaders of the collaborative serve as mentors for the entire cohort of Aspire fellows, meeting with them every other week and individually when a fellow wishes to discuss other personal or professional matters.

Mentoring Outcomes and Lessons Learned

Program Outcomes

The use of qualitative and quantitative data to assess the benefits of mentoring to both the mentor and protégé are a key to project evaluation. In particular, instruments that measure URM students' perceived gains are used to improve programmatic aspects of a project, such as mentoring training and

seminar content. Graduate students report perceived gains from the project's developmental activities. They also indicate that they are applying material learned through mentor-guided professional development activities, that information provided by their mentors is useful for their development, and that the material discussed during mentoring meetings is relevant to the type of work they do.

The COVID-19 pandemic has increased the importance of support for URM students in STEM graduate programs. Modified evaluation protocols now assess the impact of unique stressors and support that URM students experience during the completion of graduate programs. Recent survey results identify unique barriers and supports that arise from high-stress experiences. For example, students express that there are personal, professional, and academic barriers present (e.g., job loss of family members, reduction in time available in the laboratory, and demands related to hybrid or fully virtual course delivery). They also express that they experience significant support via mentoring (e.g., regular supportive contact, access to technology resources, and financial support).

The West Texas Regional Collaborative is now in its fourth year of funding. As mentioned above, since the inception of the program, a total of 41 Aspire fellows have been paired with community college faculty mentors. Statistics on degree completion and employment at community colleges is work in progress. In contrast, the Bridge to the Doctorate has been in existence for nearly two decades. Since then, a total of 144 graduate students participated and were paired with university faculty mentors. Of these, 111 (67%) earned either an MS or a PhD degree. In addition, 25 (17%) are still making progress toward their graduate degree. A remarkable outcome is the PhD completion rate of BD fellows, which may be as high as 65%, a number that is comparable to the completion rate of majority students reported by the Council of Graduate School in the PhD Completion Project.

Sustaining the Programs

While the term sustainability speaks to the ability to maintain a project at a given level, institutionalization is the result of establishing a new norm in the culture of an institution due to the project's impact on people. Sustainability and institutionalization of a mentoring culture are slow but crucial processes with key indicators such as levels of encouragement, participation, openness, and rewards that reaffirm cultural shifts and consistency but may take more than a decade to produce desirable results. At higher levels, the current plan is to engage presidents, as well as vice presidents of academic affairs and graduate studies, who will proclaim the importance of graduate student enrollment and success and set policies to implement a system of rewards and incentives for faculty members who shine as exemplary mentors. The plan also includes engaging deans and their team of academic program chairs to execute the system of rewards and incentives and collect departmental data that demonstrate the impact of mentoring practices on graduate student satisfaction and degree production, taking advantage of infrastructure already developed for the accreditation of graduate programs.

In addition, current external funding has been secured for a multi-institutional mentoring research center that provides services to faculty and programs within participating institutions and to other institutions. The vision of the center is for professors to maintain inclusive environments for discovery and learning that lead to productive research enterprises. Ultimately, graduate students from all diverse backgrounds will develop professionally through inclusive mentoring experiences and benefit from the

versatility of their earned degrees, securing jobs contributing to the diversity of the STEM workforce.

Lessons Learned

In its more traditional form, mentorship is a bilateral commitment that positively affects two individuals engaged in a professional relationship at the graduate level. Newer models for mentorship extend the relationship to more individuals, but the goals are the same: academic success and productivity. For URM graduate students, the added value of a mentorship experience lies in the validation of their background, assets, strengths, and accomplishments, the opportunity to complete a professional identity in a safe space created by the mentors and those who seek them. On the other hand, evidence suggests that poorly matched mentor-protégé dyads lead to frustration on both ends, extended times to degree, and, what is worse, student departure.

The set of desirable outcomes to assess the impact of a mentoring project may vary from project to project but aim to be participant-centric. For URM graduate students, the metrics include participant level of satisfaction with respect to programmatic activities and mentorship experience, perceived attitudinal changes and skill acquisition. Additional metrics of institutional value should include degree completion rate and average time to degree.

Mentoring projects reflect the institutional mission, provide evidence of a culture of inclusiveness, and are a point of pride for the institution. Support and coordination at all levels are fundamental to maintaining effective mentoring efforts. Forms of institutional support must include mentorship training for faculty with opportunities for mentor-protégé socialization, recognition for participants, and awards for outstanding mentors. Nominations for awards such as the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring spearheaded by Academic Affairs are always a possibility for the truly deserving. Conversations to promote effective mentoring practices are already taking place within the Academy of Distinguished Teachers.

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