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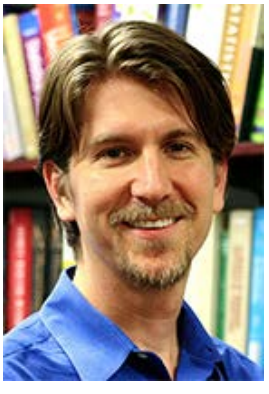
INCREASING THE NUMBER OF UNDERREPRESENTED STUDENTS IN STEAM DISCIPLINES AT THE GRADUATE LEVEL



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Increasing the Number of Underrepresented Students in STEAM Disciplines at the Graduate Level

1. Introduction

The McNair Scholars Program at Loyola Marymount University (LMU) is one of more than 150 so-named programs federally-funded by the U.S. Department of Education and has the overarching goal of increasing the number of graduate degrees awarded to students from underrepresented segments of society. In this paper, we will give an overview of the various components of the program at LMU and will address the rewards and challenges of the program at multiple levels.

2. Background

The LMU McNair Scholars Program provides the structure necessary to sustain a support system for a qualified group of first generation, low-income, and underrepresented participants. The program comprises of McNair Scholars, their families, and the *LMU McNair Team*. Each academic year, we identify and address the higher education needs of 26 first-generation, low-income and underrepresented undergraduates in STEAM disciplines who are interested in attending graduate school. The target population consists of students who meet the low-income criterion as per TRIO guidelines and are first-generation college students. The program also targets students who are underrepresented minorities in higher education, though non-minorities are included if they are both low-income and first-generation per TRIO[1] guidelines.

3. LMU McNair Scholars Program Structure

LMU McNair targets the sophomore class and incoming junior transfer students to identify a pool of program candidates. This target population is recruited from the LMU Frank R. Seaver College of Science and Engineering (SCSE), which has 100% STEM majors, and students majoring in Economics, Political Science, Psychology, and Sociology in the Bellarmine College of Liberal Arts (BCLA). An effort is made to ensure a gender-balance so as to also address the issue of women underrepresentation in STEM.

[1] The Federal TRiO Programs (TRiO) are federal outreach and student services programs in the United States designed to identify and provide services for individuals from disadvantaged backgrounds.

3.a. STEM Focus

The LMU McNair program incorporates ideas and methodologies designed to increase the number and proportion of students prepared for graduate study in STEM. Our program recruits academically talented, dedicated STEM students from LMU's diverse student body. To ensure the baccalaureate graduation and future doctoral success of the STEM students it serves we use the following strategies.

Student support: The collaborative interactions of the Director, McNair Scholars, Faculty Mentors, the Research Advisors, and the rest of the McNair Team yield personalized and improved advising for McNair Scholars in the STEM fields and direct them into rigorous coursework and experiences that prepare them for research. The engagement of the scholars in the two-year McNair seminar brings together STEM students as an academic community, thus helping them build a peer network that can push them to graduate school and a career in STEM. The promotion of opportunities to attend regional and national conferences, present research, and interact and network with peers and faculty from other campuses, promotes their growth as scholars in their STEM discipline. Moreover, LMU McNair educates scholars' families about the importance and benefits of pursuing post-baccalaureate education, and these family members in turn become supportive partners in their children's pursuit of STEM graduate degrees and careers.

Undergraduate research: McNair Scholars engage in research, collaborating directly with active scientists both at LMU and other institutions, companies or agencies. This provides the scholars with a supportive and encouraging environment in which to conduct STEM research and envision themselves as scientists. More details about the research component is provided in section 3.c.

Faculty: Faculty Mentors and Research Advisors are all full-time LMU faculty, most of whom come from groups underrepresented in STEM, including women, and some of whom are former McNair Scholars themselves. They work one-on-one with McNair Scholars, and these close interactions allow for development of student talent in STEM.

McNair seminar: A carefully designed 4-semester McNair seminar class, as described below, develops students to STEM researchers. The scholars' close interactions with the full-time, tenured or tenure-track faculty on the McNair Team, places them in a supportive environment as they grow in STEM.

3.b. Personnel and Interactions

The McNair Scholars Program at LMU is comprised of a team consisting of a Director, a Program Coordinator, graduate assistants, faculty research advisors, faculty academic mentors and an advisory board that provides support for our 26 scholars. Student support is provided through complementary and synchronized efforts between all divisions of the program.

However, the Director is central to the program and is directly responsible for all aspects of the program ranging from budgetary issues to guiding students throughout their academic journey.

The primary responsibility of the Program Coordinator is to ensure that administrative matters are coordinated and executed in a timely fashion. That said, our Program Coordinator has engaged with the students and support faculty and staff in a way that has become more directly integral to the students' success. Our Program Coordinator has an understanding of the research conducted by the students and keeps a pulse on their overall academic and personal activities. In addition, the Program Coordinator is directly responsible for communicating with, and designating tasks to, the graduate assistants. Without the support of these additional team members, it would be impossible for the Director to carry out all the tasks required to ensure a thriving program. For example, we often have 26 scholars who are simultaneously putting the final touches on research posters that they will be taking with them to conferences. They are required to send digital versions of these posters to the McNair team so that the Program Coordinator can arrange to have them printed. Despite the fact that the posters should have been properly handed over by the students to their research advisors for proper vetting, there are often cosmetic, structural and substantive issues that must be addressed. At this juncture, the labor is divided, and the entire team, including the Director, Program Coordinator and the graduate students thoroughly review the posters with the scholars one-on-one, often over a very short two- to three-day period.

Membership on the advisory board includes faculty members and administrators who have a significant knowledge about the opportunities and challenges encountered by students from underrepresented backgrounds in STEAM fields as well as individuals who have a solid understand of current research trends. The advisory board guarantees the inclusion of fresh ideas, which is of particular importance since the landscapes of research programs in both academic and professional settings are constantly evolving.

3.c. Focus on Research

Preparing undergraduates for doctoral studies through involvement in research and other scholarly activities is at the heart of the program. Although we provide a significant amount of preparation and support in helping students create strong graduate school applications, the emphasis of the program is really on ensuring continued student success after matriculation into graduate school. To this end, we prepare our students for a research-driven academic experience so that they have an understanding of the rigors and culture of graduate school.

Research is emphasized through multiple modes, including the promotion of undergraduate research experiences, discussions of methodology in the classroom, and conference preparation. The Director often communicates with research advisors, both on and off campus, regarding student progress. However, in order to promote self-efficacy, the team will help the scholars understand how to maximize the benefits of a research experience, guiding them through issues ranging from communicating with research advisors to identifying sources of funding.

3.d. One-Unit Seminar Class

The Program Director designs and teaches the McNair one-unit weekly seminar courses offered each semester. During the fall of junior year, McNair Scholars focus on scholarly investigation, covering topics such as the culture of research, research tools and techniques, library skills, and how to improve writing and presentation skills. Spring semester of the junior year, the seminar focuses on preparation for graduate school. Also, during this semester, scholars attend regional graduate school recruitment fairs and visit local science and engineering organizations or companies, providing them with first-hand knowledge of professional opportunities available for them after graduate studies. In advance of these field trips, requests are made to have professionals who align with the McNair-scholar demographic speak with the scholars about their professional journey. During the fall of the senior year, the McNair seminar-class provides students with hands-on assistance in applying to graduate schools, covering topics such as completing the graduate school application, soliciting recommendation letters, interviewing strategies, thriving during the first year of graduate school, and the life of a graduate student. During their final semester at LMU (Seminar 4), students in the McNair class navigate the scholarly writing process as they prepare the results of their McNair research for submission to a peer-reviewed journal.

These seminars also include occasional dinner events that feature guest speakers from the local academic, science, engineering and technology community, including LMU faculty and alumni. The Director carefully selects guest speakers, considering gender balance and their abilities to present the nature of their work in STEM fields and to convey excitement for science and engineering, as well as for their willingness to respond to questions from students about academic, career, and personal choices.

3.e. Mentoring by Faculty Mentors and Research Advisors

The McNair program offers a customized mentorship experience for each scholar, closely tracking their progress through scheduled meetings and other frequent encounters at university events. The Faculty Mentors are full-time, tenured or tenure-track faculty members in the Bellarmine and Seaver Colleges with an active research program and demonstrated commitment to mentoring undergraduates. They are committed to serving, and have empathy regarding the challenges faced by first-generation, low-income and underrepresented students of diverse cultural and ethnic backgrounds. Faculty Mentors have a demonstrated commitment to guiding undergraduates as they build a competitive graduate school application, with all the required components including statement of purpose, quality research experiences, supportive letters of recommendation, etc. Such mentoring activities will yield the intended objective of graduate school enrollment, persistence, and Ph.D. attainment. Similar to the Faculty Mentors, the McNair Research Advisors are accomplished in their field and are recruited from all majors pursued by LMU McNair Scholars. They have experience directing rigorous undergraduate research projects and have a demonstrated commitment to mentoring undergraduate students through all

components of research. There are McNair alumni who are full-time faculty in the Bellarmine and Seaver colleges, and an effort is made to include them in the collection of Faculty Mentors and Research Advisors.

3.f. Financial Support

McNair program provides direct financial assistance for the scholars in a variety of different ways. Such support include assistance with the graduate school application process, GRE test preparation and test registration processes, support for conducting summer research at LMU, and support for attending conferences. In addition, the McNair Team provides assistance with the graduate school application process, provides assistance in securing financial support to finance doctoral studies, monitors participants' needs to ensure that they are receiving necessary services, provides opportunities for McNair students to visit Ph.D. granting institutions and their departments of interest, and communicates with parents of the participants to advance their understanding of the benefits of attending graduate school and generate support for their child's decision to enroll in a Ph.D. program.

3.g. Summer Experience

Since an understanding and familiarity with research is paramount to success in graduate school, the summer is an opportune time for undergraduates to gain first-hand research experiences of their own. To broaden our students' understanding of academia, we highly encourage them to seek research opportunities outside their home institution. In the spring of their junior year, our scholars are required to investigate options at other universities, government labs, and research centers for the summer. In addition, they must identify and communicate with a faculty member at Loyola Marymount University with whom they would be interested in engaging in a research project.

Many of the sites that offer research experiences to undergraduates during the summer provide additional programming such as GRE training, conference preparation, and sessions to develop presentation skills. Consequently, for those students who elect to remain at LMU to conduct research during the summer, we have constructed a rigorous framework to complement their research activities. Once students have identified a faculty member with whom they wish to work, they must write a proposal that outlines their course of action for research during a period that extends for eight weeks in the summer. During those two months, our McNair Scholars meet on a weekly basis to present their work to a panel of approximately six rotating faculty members, called summer associates. We have roughly 15-20 faculty members that participate in our weekly sessions, which always begin with an informal dinner that includes conversations about issues surrounding research, graduate school and academia at large. This is followed by a director-led discussion or presentation on topics such as making the most out of conference attendance, putting together poster presentations, or preparing for the GRE. Afterwards, the students deliver formal PowerPoint presentations on their research progress, which is the central focus of the evening.

In the beginning weeks, students are essentially providing an overview of their plans for the upcoming months. At this juncture, our faculty panel members provide constructive feedback about our scholars' presentation style, delivery of content, and then pose demanding questions. The students already had their own research advisors over the summer, but this was an opportunity for them to present their work to an educated audience who knew nothing about their work (or even their field). Our goal was for them to gain a deep enough understanding of their investigations that they can articulate their progress to someone outside their college. From the first week to the eighth week of the summer sessions, feedback from the faculty panelists evolves from commentary about stylistic choices to challenging questions about methodology and the conclusions that students made in their research. Our intention is for our students to gain an understanding of the experiences they will face when they present their research in multiple venues.

3.h. Conference Preparedness

After our senior scholars engaged in research with faculty over the summer, we continued to provide workshops during the school year, which focused on presentation skills, conference preparation, and an overview of graduate school preparedness, including a GRE preparation course. After the summer, our students presented at multiple external venues, which included the Berkeley McNair Symposium, the national SACNAS (Society for the Advancement of Chicanos and Native Americans in Science) conference, and the SCCUR (Southern California Conference on Undergraduate Research).

We used a multi-faceted approach in preparing our students for these conferences. All of them had given multiple talks in front of different audiences on campus. Students were provided opportunities to present their research to LMU faculty, students, researchers, and administrators at events such as the LMU McNair Induction Ceremony and Welcome Event, the LMU McNair Scholars Convocation, the LMU McNair Symposium, and for those who remained on campus during the summer months, at the weekly summer workshops.

Many of these conferences included workshops that complemented and reinforced the ideas we discussed with the scholars during the year. We require students to attend these workshops, and we encourage them to network with researchers at different levels, including faculty members, government and industrial workers, post-doctoral researchers, graduate students, and other undergraduates. So that students feel more at-ease when trying to network in an unfamiliar environment, we prepare them to give one- to two-minute "elevator speeches" in order to break the ice with other researchers.

3.i. Engagement with families

In the fall, family and friends of the scholars are invited to attend the LMU McNair Scholars symposium, which is a day-long event. Since the majority of the scholars are first-generation college students, families do not always have personal experience navigating the academic journey. In addition, they do not always have a solid understanding of what is entailed in student research. During this event, families get an opportunity to see the scholars in action. The scholars give research presentations, which is extraordinarily revealing to family members who occasionally question exactly what their sons and daughters are doing late at night in the lab. We also bring inspiring keynote speakers who tout the importance of diversifying the next generation of researchers. Perhaps most importantly, we hold bilingual sessions for the families of the students while conducting a separate workshop for the students. During these bilingual sessions, we break the families into small groups to discuss potential career paths for their children, and the level of commitment required to obtain a research position. These discussions are always intense and often emotional, as parents gain a deeper understanding of their children's aspirations and how they will have an opportunity to obtain a job with a respectable salary while influencing the future of scientific research that directly impacts the globe. Sometimes the issues discussed are quite deep and personal, and other times they are detailed and logistical. There have been numerous occasions when parents had not realized that their children will not necessarily accrue further debt while in graduate school, which is immensely important to a family who may have struggled to find the financial resources to support a college student in the first place.

4. Favorable Structural Factors at LMU and Factors that Promote and Sustain...

4.a. Faculty Member as Director

While directing the McNair Scholars Program, faculty members are often pulled in multiple directions, trying to balance the duties of teaching; engaging in department, college, university and professional service; and maintaining an active research program. The challenges that arise when a faculty member juggles these responsibilities must be seriously considered for the sake of the faculty member and the longevity of the program.

However, the advantages of having a faculty member direct the program are numerous. Faculty members usually have a rapport with their colleagues and can often communicate directly with them to gain a deeper understanding of the experiences faced by students in the classroom as well as the research lab. In addition, since faculty members are active researchers themselves, they are better prepared to have more in-depth conversations with the students about their projects as well.

4.b. Location of LMU and the Population it Serves

Loyola Marymount University is the largest Catholic university on the West Coast, located in the Westchester neighborhood of Los Angeles, California. It offers a unique and rigorous liberal arts education within a comprehensive-university setting in one of the nation's most diverse urban communities (Hispanic/Latino 47.5%; African-American 9.8%; Multi-race 2.8%; Asian 10.7%; and White/Non-Hispanic 29.4%). The university has a long-standing commitment to recruiting and enrolling high-achieving, low-income students from across the region and the state of California and providing an educational experience that is rigorous, inclusive, engaging, socially sensitive, interdisciplinary, international and global. The LMU undergraduate student body is quite diverse: Hispanic/Latino 20.7%; African-American 6.3%; Multi-race 7.7%; Asian 10.9%; and White/Non-Hispanic 44.4%.

4.c. Synergy Between Other Programs

During the year, the Director works closely with many different divisions and units across campus, including Career Development Services, the Academic Resource Center, University Relations, the Sponsored Projects Office, the Center for Student Success, the ACCESS program and the ACE Program. In addition, there is continued collaboration with directors at other sites through conferences, including the Council for Opportunity in Education Meeting, the Higher Education Programs Directors' Meeting, McNair Scholar Research Conferences, and conferences hosted by professional research organizations.

The Director often works collaboratively with programs such as the Academic Community of Excellence (ACE) on campus. The primary mission of ACE is to support students pursue their goals of matriculating into graduate and professional school. Because of the shared mission, the programs often co-host events and jointly coordinate to off-campus events like the UCLA recruitment day and the Southern California Forum for Diversity in Graduate Education.

5. Closing Remarks

The LMU McNair Scholars Program helped to create a bridge between undergraduate and graduate education for first-generation college students from low-income backgrounds and students from underrepresented groups. The participants in the program gained knowledge, skills and capacities necessary to successfully navigate graduate school through mentoring, immersion in research and a variety of other scholarly activities. The collaborative interactions of the Director, McNair Scholars, Faculty Mentors, the Research Advisors, and the rest of the McNair Team yield personalized and improved advising for McNair Scholars in the STEM fields and directed them into rigorous coursework and experiences that prepared them for graduate school.

6. Acknowledgements

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