



# Project STEP-UP

STEM Trends in Enrollment and Persistence for Underrepresented Populations



## STEM Intervention Programs at Large, Public, Research Universities: Common Trends and Challenges

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For decades, increasing the number of students who successfully pursue Science, Technology, Engineering, and Mathematics (STEM) fields has been at the forefront of our national dialogue. For reasons of developing human capital, promoting scientific innovation, securing the national economic, improving national defense, and expanding opportunities for education and social mobility, STEM education has never been as important as it is today. While many motivations for strengthening the nation's STEM capacity exist, the potential talent pool from which to achieve such goals remains less than optimal. Despite an increased presence in higher education as a whole, women and racial and ethnic minorities remain underrepresented in the STEM fields. Given historical underrepresentation and the current demographic projections of increased racial and ethnic minority populations, a "national effort to sustain and strengthen S&E [Science and Engineering] must also include a strategy for ensuring that we draw on the minds and talents

of all Americans" (National Academy of Science, 2010, p. 1).

Given the importance of improving STEM education for underrepresented groups and for increasing the nation's overall STEM capacity, Project STEP-UP seeks to examine factors that impact the matriculation, persistence, and degree attainment of women, minorities, and low-income undergraduate students in STEM fields using both qualitative and quantitative methods. Intervention programs that seek to expand access, support, and opportunities for traditionally underrepresented students within STEM fields were identified as one of many topics of interest by the researchers to be studied in depth. This paper summarizes current trends and challenges of STEM intervention programs at a set of large, public, research universities.

One component of Project STEP-UP specifically examines the design, implementation, structure, and funding of STEM intervention programs—programs housed in departments,

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colleges, and universities that seek to increase the recruitment and retention of traditionally underrepresented students in the STEM fields. Other project components include using longitudinal student-level data to examine patterns of entrance and persistence in STEM majors, and survey data that focuses on students' experiences in STEM majors. A sample of the guiding research questions for the intervention program component of Project STEP-UP are:

1. What theories or perspectives guide the design of STEM intervention programs?
2. How are STEM intervention programs structured?
3. How are STEM intervention programs funded?
4. What are the common challenges that STEM intervention programs face?

Examples of STEM Intervention Programs that were examined within this study include academic bridge programs, high school-to-college transition programs, research opportunity programs, as well as programs that offer tutoring, mentoring, advising, financial support, and social networking opportunities. In part, Project STEP-UP focused on STEM intervention programs because of the known benefits to students who participate in such programs, which includes aiding students in the transition to college and into specific STEM majors, increasing awareness of STEM majors and career opportunities, and increased access to and opportunities in STEM majors for underrepresented students. Furthermore, the project sought to provide research on intervention programs, due to the lack of empirical-based studies on the programs themselves. Of the research that exists on this topic, the majority focuses on student-level analysis, rather than program-level analysis, which can examine institutional factors that may contribute to success in STEM for underrepresented populations.

In 2010, face-to-face, semi-structured interviews were conducted with 54 STEM intervention program directors and administrators, across 10 large, public, research universities.

Thirteen men and 41 women participated in the study. The racial/ethnic composition of the participants was as follows: 25 Caucasians, 21 African Americans, 5 Latinos/as, 1 Native American, and 2 Asian Americans. In addition to the interviews, over 100 documents were collected from the intervention programs, including pamphlets, annual reports, and evaluations.

Preliminary analysis of the interview data identifies the following common themes amongst STEM intervention programs at large, public, research universities:

1. Evolution of Programs
2. Collaborative Efforts
3. Financial Support and the Impact on Delivery of Services
4. Assessment Efforts in Measuring Outcomes
5. Staff Expertise

Each theme is discussed in detail below, and recommendations are offered based on these initial findings.

#### ***Evolution of Programs***

Many of the programs included in this study have evolved over time, which is most evident in the change of the program's mission and goals. A number of programs were initially created to provide opportunities to underrepresented students to enter into and succeed in STEM

majors and colleges. A subset of these opportunity-based programs has since shifted their mission to recruiting highly-qualified students to the STEM fields. For instance, research opportunity programs that previously allowed students to explore research as a possible career, now seek to recruit highly-qualified minority students to graduate programs at the host institution. As a result, programs that have changed their mission have also changed how program participants are selected, increased student eligibility requirements, and reduced the number of students served.

The following quotes are representative of this trend:

*The [summer research] program has changed for most of [the universities that offer this program]. It was a program that was meant to provide students with an opportunity to conduct research. And so the focus wasn't necessarily on getting them into graduate school right away. Because we even took sophomores so it would be a couple of years before they could even consider that. But it was more a chance for them to work with a faculty member and to understand what graduate education was about, what research was about. And so it wasn't as rigorous of a program.*

*It [summer research program] has changed drastically in the past three years. When I started the average GPA score for students was a 3.0. And while admissible to graduate programs in STEM fields, that's not going to get you any love. So this year we are just finalizing our cohort. We're at a 3.65 [GPA] for the students in our cohort.*

### **Collaborative Efforts**

Multiple program directors and administrators spoke of collaborating with other programs, departments, and campus offices in their delivery of services to students. Collaboration was viewed as a strategic way by which to reduce duplicated efforts across the university, as well as a cost-saving measure. In addition, collaborative efforts assisted programs in creating buy-in from faculty members, garnering additional support for the program across campus, and being viewed as an integral part of the institution, rather than a supplementary (and unnecessary) program. The following quotes are examples of collaborative efforts that STEM intervention programs engage in:

*So, every department has chief advisors, and our group meets, as a whole, with the chief advisors once a month and with the associate heads of the departments once*

*a month. And at any time we can bring up women engineering issues. And we do. So, we rely on the departments to help us with the Undergraduate Research program. We rely on them to help us with the orientations with the student visits. So, I like that we're not separate. We are part of the fabric of the college. And that, I think, helps get the message out to the departments in a much more effective way.*

*Across the departments, we have a core group of people that would do anything to support these initiatives. I've been working with one faculty member for the seventeen years that I've been here, every year. And if I don't do something with him then he seeks me out and wants to know what can he do?*

### **Financial Support and the Impact on Delivery of Services**

The themes that are most salient in terms of funding intervention programs—the source of funds, program stability, and program sustainability—are interconnected. Funding sources were of great concern to program directors and administrators. Given the current context of national, state, and campus-level financial difficulties and budget deficits, program directors and administrators discussed implications for the stability of their programs in light of the financial climate. Programs were funded by a variety of sources, including hard

funds (i.e., committed campus, college, or department level funding), soft funds (i.e., grant support, sporadic campus, college, or department level funding), and corporate funds (i.e., support from the industry). The majority of programs were funded by a combination of these sources; few relied on a single source of funding.

Programs that received corporate funding spoke of how dependence on such sources made program vulnerable due to changes in the economy, even if the program proved to be effective in increasing student participation in the STEM fields. Programs directors that spoke of having hard funds from their department, college, and /or university expressed their institution's commitment to their program and related diversity efforts. In this sense, the funding of intervention programs is seen as a campus priority, with a number of programs long-term sustainability due in part to institutional priorities and commitments to diversity as evidenced through their funding decisions.

The source and amount of funding—which can be viewed collectively as the quality of funding—influenced program aspects such as personnel, service delivery, the number of participants, and even the program's existence from year to

year. Some program directors indicated that they had to write grants to raise funds to pay for their own salaries, which detracted from other important activities, such as delivering services to students and assessing the program. Fluctuating funding, primarily in the form of soft funds, also contributed to staff shortages and turnover.

When asked about how the intervention program was funded, these directors gave the following responses:

*[The program] receives no funding from state money...all of the funding comes from the industry.*

*Our programs—part of our programs are also supported by the dean and the dean’s structure, like the program that is supported by the dean through their corporate funds that they raised. Some other programs are funded by our own efforts, through our alumni, through some proposals that we write. I think it’s appropriate for us to do a little bit of proposal writing. And the perceptions there would be, “If we have an idea, let’s raise some funds to support it. But if it’s an important idea, then the dean should be involved.” I’m glad to say he has been very involved to support some of the ideas that we have.*

*Gift money, grant money, things like that. He [the Dean] gives us zero money for programs. Now, there have been times where we’ve been not doing as well raising money, where the dean will do something that he calls back stop our programs. So, you have to plan six or eight months in advance. You may not have the money yet. It’s like if you don’t start the planning, waiting on the money, then you’re not going to have the program. So, he’ll say, “I’ll back stop the program, which means that if the money doesn’t come in, I’ll guarantee it, but keep trying to get the money and keep planning the program.” Usually, the money comes in, and it’s okay. But if he has to give us a couple hundred dollars at the end, he will. So, mostly he hasn’t had to. But the fact that he’s willing to do that allows us to plan.*

**Assessment Efforts in Measuring Outcomes**

Evaluation and assessment are important for programs to demonstrate their value, worth, and impact to various audiences. In addition, assessments aid in generating knowledge of what interventions and services work best for which students, and in informing decisions related to funding and programing. However, many program directors expressed difficulty conducting evaluations and assessments. The challenges they

cited included lacking staff and resources to complete evaluations. The lack of assessment efforts and evaluations conducted contributes to the lack of empirical-based research available regarding measurable outcomes and benefits of STEM intervention programs. In addition, programs that are unable to systematically and regularly offer evaluation or assessment results may have increased difficulty in obtaining funding, as proving to potential funders that their program is worthy of investment may be difficult without showing measurable results or tangible benefits. One program officer indicated the following in regards to assessment efforts:

*That is our big weakness. There have been periods when the evaluation has been better than others. And so, I’d have to say we get a D-. The best we do anymore in the last couple of years has been to provide data for the Central Database. We have had opportunities to track students, but when the staffing changes – there’s no excuse. We have not done it, even though we know and I know that we need to be able to predict. Much of what we do now is more anecdotal than I’d like.*

Another program administrator offered the following commentary, which highlights the difficulty in knowing what as-

pects of programs will be most beneficial to assess:

*So, no, there's been no evaluation. There's some pressure to do it. I've asked, I mean, I got to the point where I asked the associate director flat out, "What are you looking for? Do you want me to just give you percentages? Or, do you actually want me to start gathering data or getting general information about our students versus other students, for example?" And trying my best to do some sort of regression analyses that show differences between the two. And I sort of got a horrified look as soon as I mentioned the word regression, and was told, "No, no, I'm not sure we need that level of detail."*

The above quotes also indicate that much of the evidence that demonstrates the benefits of program interventions largely exists in the form of anecdotal information, rather than a formal evaluation that incorporates qualitative and/or quantitative methods. From a research standpoint, ideally assessments and evaluations should incorporate both qualitative and quantitative data, but again, due to shortages of staffing and resources, conducting either type of research on a program may not be feasible.

**Staff Expertise**

In examining the personnel across the intervention pro-

grams featured in this study, the general trend shows that administrators working with programs that serve women in science and engineering majors tend to be women who have bachelor's and/or advanced degrees in engineering or science fields. Some WIE, WIS, and WISE administrators and directors had even worked in the STEM industry before returning to higher education. The women directing and working with these types of programs expressed a motivation to help other women succeed in the STEM fields, and indicated that their educational and occupational credentials helped establish creditability with students and faculty members in the department and/or college.

The majority of administrators working in traditionally under-represented minority programs do not have a bachelors and/or advance degree in engineering or the sciences but in various, unrelated majors. Their educational backgrounds varied greatly, including having degrees in fields such as History, Journalism, Family Services, and English. Only a handful of administrators had advanced degrees in higher education or student affairs, indicating that few are formally trained in providing or evaluating student services.

The academic and occupational

backgrounds of directors and administrators, as well as the extent of their experience with STEM intervention programs, have implications for their understanding of research and the need for evidence to inform program development and implementation, as well as their ability to carry out these tasks. Although some administrators lacked research and evaluation skills, and may not have been formally trained in student affairs or services, their passion for helping students succeed may help outweigh what may be viewed as preferred credentials.

Finally, related to the challenge of sustainable and quality funding mentioned above, a number of programs rely on student workers and volunteers to provide services to program participants. Without having student volunteers, or hourly workers, many programs would have to reduce the number of services they provide. Creating opportunities for students to be involved in campus and in delivering the services of a STEM intervention program may be beneficial, but only to the extent that such opportunities do not detract from those students' own progression through STEM majors.

**Recommendations**

Based on the initial impressions of interviews with program

directors and administrators, we offer the following recommendations:

*Pursue stable, recurring funding*

- Determine current sources of funding, as well as the quality and sustainability of each source.
- Seek out additional sources of recurring financial support.
- Advocate for year-to-year support from departments, colleges, and/or campus by demonstrating value and worth of the services provided to students via a formal evaluation.
- Provide grant writing seminars for staff.

*Purposeful Staffing*

- Hire staff that have the expertise and skills needed to effectively direct and administer intervention programs.
- If budget restrictions do not permit for a full-time or part-time evaluator, partner with the College of Education or other appropriate college or department on campus to hire graduate students to perform program assessments and evaluations.
- If the College of Education offers courses in student affairs, higher education administration, and/or evaluation methods, ask current staff members to enroll in or audit these courses for professional development purposes.

*Collaborate*

- Investigate opportunities for collaboration and partnerships inside and outside the department, college, and/or university for service delivery, program design and modifications, program assessment and evaluation, and funding.
- Look for duplication of services between different types of program interventions and collaborate on such services where feasible.

*Advocate*

- Work towards making STEM intervention programs key to the campus, college, or departmental mission, particularly as it applies to diversity of and access to the STEM fields.

**Concluding Thoughts**

As the nation seeks to strengthen the STEM workforce, STEM intervention programs that expand opportunities for access and success to women and underrepresented minorities are one of many viable avenues by which to achieve national goals. The National Academy of Sciences (2010) urges an “urgent, sustained, comprehensive, intensive, coordinated, and informed” attempt to improve STEM education and the workforce (p. 5). STEM intervention programs are just one piece of such an effort. Although the challenges and obstacles that face STEM intervention pro-

grams affect the delivery of services to underrepresented students in STEM, such programs are one of the many factors that positively impact the recruitment, retention, and persistence rates of traditionally underrepresented students. Intervention programs that benefit from stable and continuous funding, assessments and evaluations, adequate staffing, and campus-wide collaborations are best suited to fulfill their mission and goals of helping underrepresented students succeed in the STEM fields, as well as contribute to expanding the STEM talent pool.

**References**

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