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Essay

Navigating Proposal Writing and Implementation of an NSF S-STEM Grant Program: Reflections as a First-Time PI

Bernadette J. Connors

Dominican College of Blauvelt

Abstract

Recruitment and retention issues are an increasing concern to many institutions nationwide, most especially in regard to underrepresented minority (URM) students enrolled in STEM. It is, therefore, incumbent upon colleges and universities to educate and inform themselves on best practices in supporting their students, in order to create an atmosphere that fosters confidence, success and aptitude. At my institution, I began this process by requesting support from the NSF S-STEM program, which supports scholarships for academically talented, low income students majoring in a STEM discipline. It was the first-ever proposal and award of this type for me and, as such, there was a steep learning curve in its writing, preparing, and implementation. This essay will reflect on the challenges and successes I faced, as well as the opportunities this process provided for me as an educator and STEM professional. It will also provide suggestions and offer advice on key elements to being successful in this endeavor.

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***Correspondence to:** Dominican College of Blauvelt, 470 Western Highway, Orangeburg, NY 10962, bernadette.connors@dc.edu

INTRODUCTION

Innovation is tied closely to the nation's strength in the areas of science, technology, engineering, and mathematics (STEM). To meet projected workforce needs in a post-COVID world, the President's Council of Advisors on Science and Technology (PCAST) recognized the necessity to broadly invest in STEM education (President's Council of Advisors on Science and Technology; White House, 2020). Nationally, fewer than 40-60% of undergraduates who intend to major in STEM complete their degree and for underrepresented minorities (URMs), this number is significantly lower (1-3).

Retention and student success in STEM programs are, therefore, a concern to many undergraduate institutions (4,5). Factors contributing to student attrition include financial problems, difficulty in social and academic integration, perception of the lack of institutional commitment to student success, and negative campus climate as a result of low diversity and inclusivity (6-9). Educational disparity has been systematically examined with respect to gender, race and ethnicity, and socioeconomic status (10-13). Extensive research is also available regarding the positive impact on student retention and success when transformations to pedagogy, accessible professional development opportunities, assessment and evaluation design, and culturally cognizant support services are implemented (14-17). Additionally, a greater number of funding opportunities for undergraduate STEM programs and scholarships have become available through both public agencies and the private sector.

The National Science Foundation (NSF) has a strong history of supporting undergraduate and graduate STEM education. One such program is the S-STEM program, which has supported scholarships and program innovations in STEM disciplines at institutions of higher education, ranging from community colleges to primarily research universities (www.nsf.gov/pubs/2020/nsf20526/nsf20526.htm). This program is under the purview of the Division of Undergraduate Education (DUE) and the Directorate for Education and Human Resources (EHR). The most recent solicitation describes three tracks to which an institution may apply, with funding requests ranging from $650,000 to $5 million. For each of these tracks, 60% of the total requested funding must be dedicated to providing scholarships to academically talented, low income students. The remaining funds can be used to implement evidence-based high impact practices aimed at supporting the scholarship recipients. This allows each institution to address the needs of their unique student population, thereby empowering the STEM program to embrace meaningful, transformative, and individualized change.

Dominican College received a five-year NSF S-STEM award to support up to 14 scholarships for low income students. The overarching purpose of the project was to educate students in Biology and transition them into graduate school or into a STEM career upon graduation. The project goals supported by the proposal were to increase opportunities for the S-STEM scholars that would enable them to complete their Baccalaureate degree in Biology within four years, provide internship, research, and mentoring experiences, and increase retention of students to degree completion by providing support services. Specific implementation strategies for each goal were then designed and

implemented with two cohorts of undergraduate Biology majors (Specific implementation strategies in Supporting file S1. S-STEM writing and management – Specific implementation strategies).

This was the first ever NSF award on which I was the principal investigator. Based on my experiences writing a funded proposal and managing the program, this essay will reflect on the challenges and successes I faced, as well as the opportunities this process provided for me as an educator and STEM professional. It will also provide suggestions and offer advice on key elements to being successful in your own S-STEM journey.

KEY INGREDIENTS TO WRITING A SUCCESSFUL PROPOSAL

Deep understanding of the program solicitation

As for all grants, understanding the requirements laid out in the program solicitation is critical. Not only will it provide you with clear expectations for preparing the proposal itself, but you will find a wealth of information regarding eligibility, funding availability, budgetary limitations, and review criteria. The solicitation also provides references you can use to begin collecting evidence to support your project goals and implementation strategies. Although the primary objectives of the program are consistent from year to year, various criteria are oftentimes modified; thus, you need to use the most recent program announcement as your guide. Of great help in understanding the solicitation are webinars and virtual office hours offered by NSF. Not only are these direct means by which you can have your questions answered, but they are excellent opportunities to connect and garner advice from the program officers.

In addition to the program solicitation and officers, there are other resources to aid you in developing your plan to broaden participation, a required component for a successful NSF proposal. For instance, Advancing Research Impact in Society (ARIS) maintains a collection of documents that inform effective practices to reach your target population and offers training opportunities, virtual office hours, and webinars (https://www.researchinsociety.org/). The Hispanic Serving Institution (HSI) Hub is another valuable resource that offers grantsmanship workshops, networking opportunities, and a monthly newsletter highlighting results from many successful programs (https://hsistemhub.org/).

Understand the time commitment and seek collaborations

The time and effort needed to write a competitive proposal are not to be underestimated. If you find yourself at an institution with an office of sponsored programs or a professional grant writer, leveraging those resources can help reduce your workload. If, however, your institution does not have either, as was my case at the time, the learning curve can be steep and the time commitment far greater. Combined with your teaching and service responsibilities, finding the time to take on a project of this size can be intimidating. Strategically scheduling the planning and writing process during semester breaks is logical, but not always possible if the program solicitation release and proposal due date occur during the academic semesters. It is worthwhile to request a course release if writing this proposal is supported by your administration or a persuasive argument for its need can be made.

Leveraging other existing resources at your institution to help with program development is highly valuable and perhaps critical in developing a competitive proposal. Networking among your colleagues might offer insight into what they are already doing to promote student success, and allow you to rely on existing resources. Drawing on different perspectives can also provide insight into students as individuals outside of the classroom, which might help you to develop a more holistic, culturally cognizant, and supportive program overall. As academics, "reaching across the aisle" to student development and activities offices is not something we do on a regular basis, yet their staff have a student-centered mindset and can aid your planning of educational opportunities and events that might be offered in your S-STEM program.

On-boarding colleagues early in the process has the benefit of extending ownership of the program and reducing potential feelings of being ostracized. Although the institution is the awardee of the grant, it is administered by faculty and staff and each person needs to have a sense of their importance in making the project succeed. It is important that they also be included as coPIs or key personnel and contribute to project management. Utilizing their expertise in scholar application review, recruitment and outreach, and organizing activities will present the S-STEM scholars with a united institutional effort to promote their success. This is especially important for smaller departments because it can also help to transform how STEM education is approached at your institution.

Know what your institution needs

A detailed landscape analysis of your institution and department is essential in the development of your proposal. In certain program solicitations it is, indeed, required. This allows you to better understand the students' needs and will inform your core objectives and goals. At a minimum, the types of archival data you should collect include retention rates, financial aid needs, and survey results that indicate potential causes for attrition, making sure that these are documented according to demographic categories. Reading through accreditation reports, programmatic evaluations, and data-centered fact books are great places to begin your landscape analysis. To better understand how your institution compares to others and to examine national trends, there are several resources that provide a plethora of longitudinal data, including the National Center for Education Statistics (https://nces.ed.gov/ipeds/) and the National Science Board (https://www.nsf.gov/nsb/).

Staying true to the mission of your institution and program is an important but a sometimes-overlooked factor. Using the college's mission as your guide will help focus your planned activities and ensure that the administration will support your efforts. It might also mean that data is likely available to strengthen your proposal. Oftentimes, five-year institutional and programmatic reviews provide vital information about what is needed to effectively support your student population. These reviews can also inform your assessment and evaluation plans (see below).

CHALLENGES IN PROGRAM IMPLEMENTATION AND MANAGEMENT

Recruitment

Once the proposal is submitted, there will be a period of several nerve-wracking months before you know anything of

the funding decision. Oftentimes, if the proposal was reviewed favorably and is being considered for funding, a program officer may reach out to you for clarification on one or more items. These are primarily concerns brought up by the reviewers; thus your explanations will help the program officer better understand your project before a final funding decision is made. While this is going on, you should begin thinking about the next steps.

In the proposal, you will have described your outreach, recruitment, and selection strategies for student cohorts and faculty mentors. Because the timing of the funding decision might not align with the academic year, enlisting your first cohort of qualified students in a timely way might be difficult. You should have outreach materials, applications, and a participant selection committee in place prior to the award so that student applications can be reviewed on receipt. Another strategy is to build these steps into your timeline. It is important to remember that this is not just a financial scholarship; it is a scholarship program. It provides much more than just financial support, and thus it is important to choose students who are ready and willing to make the most of this educational opportunity. Being methodical in these initial steps is very important to running a successful program.

Assessment and evaluation

The solicitation requires that you carry out assessments and have an evaluation plan led by an external evaluator. These are necessary to ensure knowledge generation about the students, and to provide evidence that the program is effective in supporting students. The external evaluator can be recruited from within your institution but should not be listed as key personnel in your proposal. This type of evaluator is valuable since this person will be familiar with your student population and the nature of the institution's mission. There are several firms, however, that specialize in external evaluation and have worked on other NSF-sponsored programs. In cases where your project aims to serve a certain demographic, you may want to seek out services of an agency that has an established record in assessing programs that support that particular demographic. For instance, if your institution is designated as an HSI, hiring an evaluator with expertise in evaluating programs serving Hispanic students might be a better choice for you. In either case, you need not be an assessment expert, as the evaluator will work closely with you to devise effective assessment tools and evaluation plans.

Showing off your successes

As part of the proposal, you will need to describe how you plan to disseminate your work. The go-to is publication in peer-reviewed STEM education journals, which is worthwhile and has added value if you are seeking tenure and promotion. Alternative ways, however, may allow your successes to be disseminated to a broader community. I would argue that, for faculty at PUIs who have a heavy teaching load, regularly accessing and reading the primary literature is not always possible. Finding ways to disseminate your findings by way of professional organizations, list-servs, blogs, or social media can be very valuable to those who have limited time and resources.

You will have the option of presenting your results each year in your annual reports to the NSF, which is read and approved by your program officer. They will offer important suggestions and/or validate what you have done with your students. Annual and final report templates are available at research.gov, and these can be downloaded and reviewed prior to submission. You will also need to report results of prior NSF support in other proposals you write. These annual reports can help you to write this section in a way that relays your true successes to the panel reviewers.

CONCLUDING THOUGHTS

Before I wrote this proposal, I did not consider the ways I might support myself through the process. Here I will describe lessons learned that would certainly guide my process in the future.

1. It was suggested that I sit on a review panel. For someone concerned about not having enough experience, this was difficult to imagine, and so, I did not. I have since had opportunities to serve as a reviewer for various programs. It is inspiring to see the amazing ideas that are proposed and the passion within the educational community to broaden participation and advance knowledge. I truly believe this is a must if you plan to submit your own proposal.
2. One of the budgetary limitations is that students who are not in the S-STEM program cohorts cannot be supported in scholarships or activities. For our S-STEM cohorts, we budgeted funds for them to present at national conferences and participate in educational field trips. Budgetary restrictions, as laid out in the program solicitation, however, did not provide such funds for those not in the cohorts. For this reason, and in order to prevent those not in the S-STEM cohort from feeling ostracized, it is important to ask your institution to commit means to support them, as well.
3. I was able to speak directly to a program officer at the NSF site who was willing to review my plan while in development. This was certainly valuable in thinking about the program, but it also boosted my confidence and, thereby, my ability to write a competitive proposal. Reach out to the program officers and seek their input.
4. Regarding your budget, the Proposal & Award Policies & Procedures Guide (PAPPG) outlines allowable costs. There are also program specific budget categories included in the solicitation, which may change if and when the solicitation is revised. Understanding "necessary, reasonable, allocable, and allowable" items and how to communicate my request effectively in the proposal was extremely confusing for a first-time grant writer. The program officer was invaluable in this process, should you find yourself without other avenues of support.
5. Seeking out example proposals and advice from past S-STEM recipients can be of great benefit. Their successes and roadblocks can impact your journey in both writing and implementing the program. After the panel review and a first indication that we might receive the award, I was able to connect with a past awardee who shared with me his advice in addressing concerns brought up by the reviewers and program officer. If you do not have access to S-STEM awardees within your network, a list of awards can be found on the S-STEM web page, along with the list of current program officers.
6. Most likely, your proposal will contain a conceptual framework, logic model, and timeline that guides implementation of the S-STEM program once you receive

funding. In terms of the writing process and ensuring all of the proposal components are completed, however, it is equally important for you to construct your own writing timeline and checklist. At the time you begin the process, the updated program solicitation may not be available if it is undergoing revision. You can still complete the institutional needs assessment, begin networking with campus partners, and reach out to other S-STEM awardees. If your institution has guidelines regarding grant submission, be sure to understand requirements set forth by your administration.

7. As you implement the activities to support the program's goals, survey your cohort to determine whether they deemed them valuable to their education. Let them take the lead on deciding and planning future activities to promote community building and leadership skills. Always listen to their voices: this is their program.
8. Networking at S-STEM events and with others who have received this award will support your own work and progress. If this is your first time venturing into STEM education research, networking also helps formulate analyses and dissemination that might complement your approach.

For our S-STEM students, retention and graduation rates were higher when compared to students who did not receive the scholarship (86% of the S-STEM cohorts graduated in four years from Biology program, while 59% of students not in the S-STEM cohort enrolled as Biology majors left the college and 12.5% remained but changed majors). Additionally, other indicators of their success were (1) higher grades in their first-year gatekeeper science courses (GPA comparisons are in Supporting file S2. S-STEM writing and management – GPA comparison for first-year Biology majors in General Biology and Chemistry sequences) and (2) higher percentages of grades "A" and "B" in both STEM and non-STEM courses (Supporting File S3. S-STEM writing and management – Grade distribution comparison). The NSF S-STEM program gives colleges and universities an opportunity to support undergraduate students through a critical part of their educational journey in far more ways than meeting financial needs. Regardless of the challenges in writing and managing this program, I feel it is well worth it. I have communicated here my experience and lessons learned in the hope of encouraging others to submit their own proposals.

SUPPORTING MATERIALS

- S1. S-STEM writing and management – Specific implementation strategies
- S2. S-STEM writing and management – GPA comparison (for first-year Biology majors in General Biology and Chemistry sequences)
- S3. S-STEM writing and management – Grade distribution comparison

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