A Journey toward Obtaining Our First NSF S-STEM (Scholarship) Grant

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ABSTRACT
Computer science Ph.D. training provides numerous opportunities to prepare doctoral graduates to write research grant proposals. However, writing scholarship grant proposals is a very different process, and a newcomer might go through many attempts before obtaining their first awarded grant.

This paper documents our four proposal submissions prior to acquiring our first NSF S-STEM grant for the Department of Computer Science at Florida State University. This paper also highlights major issues to consider when writing such proposals. We hope that future newcomers will be able to avoid some of the pitfalls we encountered in obtaining scholarship grants of a similar nature.

Categories and Subject Descriptors
K.3.2 [**Computer and Education**]: Computer and Information Science Education—computer science education

Keywords
Computer science, scholarship grant, underrepresented and minority groups.

1. INTRODUCTION
The process of obtaining a doctoral degree in computer science is strongly oriented toward steering one to become a research professor. Major milestones such as the area survey and the prospectus prepare a doctoral candidate for becoming a good researcher and writing successful research grant proposals later on down the road. However, writing successful scholarship proposals is an entirely different story, since the essence of these types of proposals is administrative planning.

As a first-time applicant for any grant, we tried to gain access to examples of prior successful proposals. Since our institution has no prior examples, we had to obtain examples from other institutions through personal contacts. However, even with these examples, mapping university functions and special circumstances and needs is not always clear. In addition, it is difficult to identify the pitfalls to avoid, which are often documented in reviewers' comments, especially on prior failed proposals, which people are less willing to share.

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This paper documents our four submissions prior to obtaining our first NSF S-STEM (Scholarships in Science Technology Engineering and Math) grant [2013] for the Department of Computer Science at FSU (the Florida State University). The purpose is to highlight various issues raised by proposal reviewers, so that future newcomers can avoid some of the pitfalls we encountered in obtaining scholarship grants of similar nature.

2. The NSF S-STEM Grant
The NSF S-STEM grant creates the scholarships to promote participants in the areas of science, technology, engineering, and mathematics, to mentor and support students through degree completion, and to partner with employers to facilitate student career placement in the STEM workforce. A scholarship recipient must be a U.S. citizen/permanent resident, a U.S. national, or an otherwise qualified alien and must demonstrate academic ability and potential as well as financial need (as defined by the Free Application for Federal Student Aid (FAFSA)). The total proposed scholarship amount can be up to $600,000 for 5 years, and each full-time student can receive up to $10,000 per year, depending on financial need.

The proposal instructions are straightforward. However, we have gone through four iterations prior to obtaining this grant.

2.1 Why Single Out Computer Science?
The percentage of computer science students enrolled in STEM has remained low (Figure 2.1.1) [NSF 2012]. In addition, the growth rate of the computer science major needs to be at least 20% in order to meet the 760,000 job openings by 2020 in computer and information technology as projected by the U.S. Bureau of Labor Statistics [Lockard and Wolf 2010].

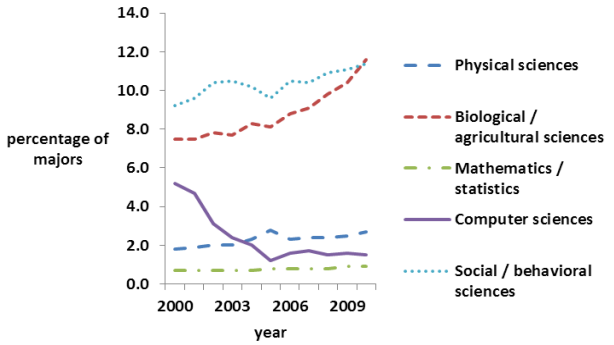

Figure 2.1.1. Percentage of students enrolled in STEM majors [NSF 2012].

3. First Attempt (Failed)

For our first attempt, we gathered examples of successful proposals from a top research university (with more than 6,000 STEM undergraduate students) and a top teaching university (with more than 700 STEM undergraduate students). For research universities like FSU, the scale of operation can allow scholarship grants to be targeted toward only computer science students. Teaching universities have to target more general STEM students because of the small size of their computer science departments. Also, the level of coordination within school units and operation can vary widely. For example, one university allows a cohort to live in the same residential hall, which we cannot easily provide. In addition, since we had no prior similar scholarship grants, we cannot build our proposal on the success of previously proven support infrastructure.

We learned about the existing student support infrastructure on campus and included it in the proposal, along with the many opportunities for leadership and K-12 outreach within our department. We included the ideas for collaborating with the biology department to increase the number of women and underrepresented students, and we aimed to sponsor two fully funded cohorts of entering freshmen for four years. The cohorts are co-registered in courses to promote opportunities for collaboration and retention.

3.1 Reviews

The review came back with G (good), G, G, and VG (very good), and here are the major comments: (1) Our *selection process and contents of application packet are not defined*, (2) *What happens if a student does not qualify for renewal of the scholarship?* (3) One reviewer observed our *good outreach plan*, while the others thought that we have *too much emphasis on engaging students in outreach activities*. (4) *More faculty involvement is needed*. (5) In terms of our collaboration with the biology department, we need *validation of institutional support (letters)*.

3.2 Response to the Comments

Prior to updating the proposal for the next round, we should first address comments from the reviewers.

3.2.1 How to Select Students?

Three components of our selection criteria include academic qualification, personal qualities, and recommendation letters.

Academic qualifications: One concern is that scholarships are awarded to talented students who will complete the degree regardless of the availability of the scholarships [Baker and Finn 2008, Whalen and Shelley 2010]. To address this concern, we will extend our application considerations to the top 25% of applicants. We will also give special consideration to women and underrepresented groups.

Personal qualities: During our interviews, we will examine the candidate's motivation, leadership, maturity, persistence, and dedication to achieving a degree in computer science. Active involvement in extracurricular activities, community service, and work experience are strong indicators of such personal qualities.

Recommendation letters: Recommendation letters for applicants will complement our interview results when we consider the final scholarship recipients.

3.2.2 How to Design the Application?

To ease application processing, we can ask an applicant to fill out and upload all pieces of information that we seek such as forms and reference letters. However, the application process can be tedious and can duplicate the university application process in many ways. Additionally, the application may contain many pieces of information that are difficult to verify independently at the departmental level (e.g., citizenship status, high school GPA). For these reasons, we resort to using a one-page application with short essay questions that ask a student about his or her career goals and personal qualities. We will retrieve any associated records from the admission and financial aid offices. Depending on the extent of system integration, this approach may be cumbersome for the student coordinator, who will need to track down all related information for each applicant.

3.2.3 Scholarship Renewal

When a student fails to maintain the GPA necessary to remain in the major, we must put the student on probation for one semester to regain his/her status. It may become problematic as the remaining cohort moves on to other set of co-registered courses. The student left behind may become out of sync with the cohort even if the student remains in the program. However, since the cohort is an effective support structure, we will consider managing all undergraduate students with this cohort co-registration approach. Thus, if a student becomes out of sync with one cohort, the student can easily join another.

If a student fails to renew the scholarship for two semesters, the student will lose the scholarship. The available cohort slot will be open to other students with similar standing in the degree program.

3.2.4 Conflicting Comments on Outreach Activities

We followed the recommendation by the majority of reviewers to reduce the number of outreach activities. Our next submission also included a section at the beginning that summarized our responses to prior comments, so that the reviewers would not contradict the reviews of this round.

3.2.5 More Faculty Involvement

We added weekly gender-informed team mentoring sessions [Chesler and Chesler 2002]. We also leverage our faculty members' participation in the NSF Research Experience for Undergraduate Program to sponsor undergraduates, either in the form of an honors thesis or independent research. Most students involved in the undergraduate independent research have decided to pursue graduate degrees, and the retention rate within the mentored pool is nearly 100%. Thus, we will encourage S-STEM scholars to partake in undergraduate research opportunities. Having graduate-school-like experience will also help them in making informed decisions when choosing between going to graduate school and getting a job in industry.

3.2.6 Support Letters

Based on our experience serving on NSF panels, letters may or may not carry weight. However, in this case, we added the support letters.

4. Second Attempt (Failed)

We addressed various concerns raised by reviewers, and we made some changes to our awards. Since the scholarship award amount then was between $5,000 and $10,000, we decided to maximize the number of recipients by awarding a fixed minimum amount for students with financial needs greater than $5,000. Since we wanted students to focus on their studying, we required students to ask us for approval for side jobs (including work study).

4.1 Reviews

The second set of reviews came back with G, G, G, VG, and E (excellent). Although our proposal was declined, our rating had improved, and having one excellent was very encouraging, since someone on the panel might have been championing our proposal.

The reviewers provided the following major comments: (1) The reviewers would like to see our *current enrollments along with a desired level of achievement*. (2) The reviewers would like to have a *justification of the determination of the amount* to be awarded. Our requirement that a student should not be employed elsewhere for financial motives *appears harsh*. (3) Another concern is we only advertise to students who are already admitted to FSU, ignoring *potential students that would have applied to FSU had they known about the potential awards.* (4) Our proposal *relies too much on existing services and offers no new support system*. In particular, first-year students *need support in adjusting to college life*.

4.2 Response to the Comments

Responding to this round of comments requires much more thoughtful planning based on the data and knowledge of our department and campus.

4.2.1 Quantified Enrollment Goals

We had to coordinate with our Institutional Research and Financial Aid units to compile enrollment, graduation, demographic, and financial-need statistics within the past three years and to compare these numbers with national and state averages. Our overall enrollment trends are reflective of the national trend. However, in terms of genders, our department is 5% below the national average for female computer science student enrollments. In terms of ethnicity, we are 10% below the state average for Hispanic students and 6% below the state average for African American students. These numbers also helped us focus on how to target the scholarships to achieve realistic quantifiable improvements in those numbers.

4.2.2 What Award Amount and Duration?

Two major parameters for administering a scholarship program are the amount and duration. One option is to provide maximum support for 4 years, so that students can focus on academic pursuit. However, this minimizes the number of students we can support. Depending on the size of the target student population in the department, this may or may not lead to significant results. Another option is to reduce the support to, say, the first two years, but we need to justify the choice of time frame (e.g., based on year-to-year persistence rates). There are other possibilities.

The option we chose was partial support for 4 years, so that we could support two cohorts of 15+ students. Our target goal is to promote female and underrepresented students among our undergraduate students. We also decided to use scholarships to replace student loans, since studies have shown that underrepresented students are more debt-averse, more likely to work full-time, and more likely to leave college without a degree [Cunningham and Santiago 2008]. Additionally, the acceptance of our scholarship must not preclude other financial aid possibilities such as work study, which is crucial for students with financial need beyond what our scholarships can provide.

4.2.3 How to Reach Students?

Clearly, the simplest way to attract applicants is to advertise to students who have already been admitted to the computer science major. However, other than achieving better retention, this approach is less likely to noticeably shift the demographics within the student body.

Going beyond the department includes advertising to all students admitted to the university through various forms of welcome packages. This advertising channel precludes students who may have come to FSU if they had known about this scholarship.

To broaden the reach, in the past we have attempted to hold field trips for local high schools. However, we found that even if they are feeder schools for the university, the conversion ratio for students to major in computer science is low. Thus, we have budgeted participant support funds for student ambassadors, who can go back to their high schools (with our targeted demographic characteristics) during breaks to advertise this scholarship opportunity. We also explored the use of social networks, so that scholarship recipients can advertise to their contacts in their high schools.

4.2.4 Retention Support

We have budgeted participant support for numerous one-to-one or shared tutoring hours. Those tutoring hours will be used for diverse purposes. For example, to ease the first-year transition from high school to college, the tutors will host a one-week workshop. The program will cover topics from the perspectives of computer science students, ranging from adapting to college life and time management to study skills and campus resources. Before each semester begins, these tutors will host a workshop on the cohort registered courses, so that S-STEM scholars can start their first homework assignments early. Throughout each semester, S-STEM scholars can request either one-on-one tutoring or group tutoring based on common needs.

5. Third Attempt (Failed)

This round of the update was quite time-consuming, due to the need to interact with different campus units to gather financial and demographic information for computer science students. As we were compiling and comparing the year-to-year persistence rates of women and underrepresented groups to the rest of the student body, we found that this number can be tricky to process. Many students might skip a year before continuing due to special circumstances. In addition, a significant number of students declare their major late, which skews the persistence rate for juniors and seniors.

To reflect the mission of the STEM program, S-STEM students who change their majors to other STEM disciplines will still be supported, provided (1) they are able to retain good standing (e.g., full-time, GPA requirements, etc.), and (2) they can locate a mentor in another STEM discipline to fulfill reporting requirements.

5.1 Reviews

The reviews came back with G, VG, VG, VG, and VG ratings. The overall average rating was improving. However, the lack of an excellent rating shows that we failed to get someone excited on the panel to champion for us. This could be simply due to the randomness of the panel selection process.

The reviewers raised the following major concerns: (1) Our proposal *should include the specific selection criteria* beyond what we had. (2) The reviewers worried that *students could 'shop' the scholarship, then take the scholarship with them if they transfer to another department*. (3) Reviewers share general *concerns about the employment and career roles for a Computational Biologist*. *Is growing programs in the spirit of this scholarship program?* (4) Reviewers concern about our *ability to manage, train, and supervise* the tutors. (5) The proposal should include *an external evaluator not involved with the project*. (6) Finally, *a more detailed concise project timeline should be developed*.

5.2 Response to the Comments

Based on the comments, it seems that evaluation and dedicating scholarships to grow the computational biology program are the central concerns. The remaining concerns are more easily addressable.

5.2.1 Additional Details on Selection Criteria

In addition to the criteria we mentioned in Section 3.2.1, we added that the top 25% of students are determined by equal weightings of high school GPA, SAT/ACT scores, and the number of leadership positions held in various extracurricular activities. For example, the high school GPA for our top 25% female minority students is 3.9; SAT, 1,250 (verbal + math); and ACT, 28 (composite score).

We are aware that some high schools may not offer AP courses, and we hope that using GPA as only a part of the qualification equation can compensate somewhat for this difference.

5.2.2 Major Switching

One concern is how to handle students who switch to non-computer science majors. If a student switches to a non-STEM major, we can simply terminate the support. The trickier case is when the new major is within the STEM area; the continued support still adheres to the mission of the NSF S-STEM program. However, it becomes problematic when evaluating our outcome. It also creates an opportunity for students to "shop" for the computer science scholarship and then switch to another STEM disciplines. Thus, we decided to terminate the support if a student decides to switch out of the computer science major.

5.2.3 Scholarship Focus

We deemphasized building the computational biology program and focused on mitigating the low percentage of female enrollment in computer science [Zweben 2013]. While the causes of this situation are debatable, studies suggest that the social aspect is an important element. The nerd stereotype [Beyer et al. 2003] and long hours of socially isolated programming sessions [Declue 1997; Amelink and Creamer 2010] are possible causes for female attrition in computer science enrollment. As the world becomes entwined with computing, having a wealth of female computer science expertise is essential to avoid gender biases in areas as software application design, authoring educational software, sustaining the number of female computer scientists, and shaping the societal norm for future generations.

We further highlight the trend beyond the area of computer science that underrepresented students are less receptive to taking out student loans [Cunningham and Santiago 2008]. For example, Hispanic students are less likely to borrow student loans (20%) compared to Caucasian and African American students (35% and 43%). Debt-averse African American and Hispanic students who do not take out student loans are more likely to work full-time, and 9% to 11% are more likely to leave college without a degree. While the overall impact is felt for all disciplines, the throttling of production of computer science majors will further exacerbate the projected labor shortage.

For us to build a critical mass of underrepresented students, each cohort will enroll in the same set of classes. This enrollment scheme will create opportunities for the students to form study groups and experience a collaborative learning environment to promote retention [Cohoon 2005]. We collaborated with the computer science department at Florida Agricultural and Mechanical University, a historically black university, to provide a dual-enrollment program. Dual enrollment helps FSU recruit and retain more African American students with a small critical mass. We have developed interdisciplinary programs (e.g., computational biology and computer criminology) to work with majors with large pools of women and underrepresented students.

5.2.4 Quality of Tutors

To ensure quality, we specify that our tutors will be required to go through the same training process required by FSU for all teaching assistants and will be required to attend on-campus teaching conferences.

5.2.5 How to Evaluate Our Project?

The evaluation has two components. The external evaluation is conducted annually by a non-FSU reviewer with a research background in education. The internal evaluation is conducted more frequently by S-STEM faculty members.

Internally, we will monitor our S-STEM scholars in terms of their academic progress, professional development, and interactions with various student support infrastructures. S-STEM faculty members will communicate weekly and meet formally once a semester to evaluate the progress of the project, cohorts, and each student, and make recommendations on the renewal of scholarships. Each undergraduate course will gather surveys that identify gender and culture biases in terms of course examples, assignments, and examinations.

The evaluation component of this project will be used for both formative and summative purposes. Throughout the project, information will be gathered in order to contribute to (a) decisions about the project development, implementation and modification, and (b) strategies to improve the areas of project focus. The evaluation will culminate with analyses designed to determine if the project objectives have been met.

Ongoing formative evaluation measures will be used to identify effective components of the project and to monitor the progress of project implementation. The formative portion of the evaluation will address the following key areas: (1) progress on each of the project objectives, (2) outcome completion in relation to the project timeline, (3) incremental project impact on students

related to the expected outcomes, and (4) arising issues affecting the successful implementation of the project.

The external reviewer will conduct an annual data collection and analyses in the following areas:

1. Enrollment in various computer science undergraduate degree programs
2. Enrollment of female and minority students
3. Relative performance of S-STEM scholars and non-scholarship students
4. Internships with local or national companies
5. Rate of progress toward graduation and retention of majors
6. Semesters taken to earn a degree
7. Separations for reasons other than graduation
8. Job and graduate school placements

The reviewer will follow up on each student supported by this project who leaves the program. For those who complete a degree, we will seek to identify their placement. If any student changes to a different degree program, we will seek to identify the new program and the reason for switching majors. If any S-STEM scholars leave the university without completing a degree, we will seek to identify the reason.

In addition to participating in the S-STEM data collection activities by NSF, we will also examine and compare the interactions within each of the two S-STEM cohorts with the interactions within naturally formed student groups. We aim to understand the factors that influence the enrollment of women and underrepresented groups in computer science. For example, we can examine the correlation of the performance of S-STEM scholars with the amount of scholarship awarded, the type of support services used, student activities attended, and the extent S-STEM scholars work together. We will also analyze the surveys gathered from the gender- and culture-neutral curriculum initiative to better understand the subtle factors that can promote diversity in computer science. Resulting quantitative data will be disaggregated by important categorical variables and analyzed using descriptive and inferential statistical methods.

6. Fourth Attempt (Successful)

We deemphasized building the computational biology program and focused on mitigating the low percentage of female enrollment in computer science. We terminated the scholarship support for students who switched out from the computer science major. We recruited an external evaluator who specializes in evaluating educational programs. We added a detailed administrative timeline. Finally, in the section that summarizes our responses to prior comments, we added our appreciation for the reviewers' time to help us strengthen the proposal.

Our final review ratings for our award were G, VG, VG, VG, and E. The main concern from the reviewers was that we could not reserve the scholarship to a particular group of people; thus, when administering our grant, our decisions must be based on applicants' holistic views. Finally, the reviewers appreciated *the PIs persistence in pursuing the S-STEM grant*.

7. Lessons Learned

This paper has highlighted the major issues when writing a scholarship proposal and documented our four attempts to obtain the first NSF S-STEM grant for FSU. Overall, we present the following general lessons for future new scholarship grant proposal writers.

- ***Leverage institutional strengths***. Every educational institution is different (e.g., has access to detailed student statistics, close ties with industry). The proposal should be tailored to leverage an institution's unique strengths.
- ***Set focused and quantifiable goals***. The proposal needs to show the extent of how the limited resources provided by the scholarship can make a difference for students from certain demographics.
- ***Be inclusive***. The scholarship selection criteria should include students who might not have been able to demonstrate their potential due to financial hardship.
- ***Be specific***. Program proposals need to be specific enough for grant administrators to implement them swiftly.
- ***Address important corner cases***. The proposed program needs to address situations such as students who change majors and students who still need to work while receiving the scholarship.
- ***Streamline the application process***. The student grant application process should leverage existing university and departmental admission procedures.
- ***Address earlier reviewers cumulatively***. To avoid reviewers giving conflicting reviews in different submission rounds, state how the proposal addresses concerns from the previous round of reviews.

Finally, perhaps the most important aspect of getting any proposal funded was summarized by a reviewer in one word —persistence.

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