

Obtaining Funding and Support for Undergraduate Research

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Abstract

Over the past decade there has been a dramatic increase in undergraduate research activities at colleges and universities nationwide. However this comes at a time when budgets are being tightened and some institutions do not have the resources to pursue new initiatives. In this article we present some ideas for obtaining funding and support for building an undergraduate research program in mathematics.

1. Introduction

Nearly all colleges and universities embrace the practice of involving undergraduates in research. Some institutions are able to provide support for students and faculty mentors through internal grants and summer research fellowships. However, other institutions while recognizing its values do not have the resources to pursue these endeavors.

In this article we present ideas for establishing a track record and building an internally and externally funded program of undergraduate research. This involves obtaining funds to conduct the research and also to secure travel funds to disseminate research results. Succeeding on both fronts is likely to lead to a valuable and exciting learning experience for both students and faculty mentors.

2. Build a track record

The first step in obtaining funding and support for undergraduate research is to get experience doing undergraduate research and to document your efforts. You will not get funding if you say "As soon as I have funding, I will start doing undergraduate research." To get funding you need to convince people that you have the desire and ability to mentor students, and the best way to do this is to build a successful track record. So, how do you build a track record? Start small. Offer an independent study course or seminar in a research area for one or two students. It is helpful to offer these courses during the academic year. Depending on the institution, you may be able to integrate this as part of your teaching load, and students may be able to take the extra credits at no cost. At the end of the term, look for a place for the students to present their work. This could be in your own department, at an MAA (Mathematical Association of America) sectional meeting,

or at a regional undergraduate research conference (there are over 40 such conferences in mathematics and the cost is minimal; see [1] for list). Also, have the students write up their work and if appropriate submit it to a journal for publication (see [2] for a list of journals that publish student papers resulting from undergraduate research in mathematics). In addition, increase your own involvement with undergraduate research by attending conferences and sessions in which undergraduate students present their research, volunteering to be a judge of students' talks or posters at conferences such as MathFest or the Joint Meetings, or attending a workshop on how to successfully mentor undergraduates in research. Some examples of workshops are the MAA minicourse by Aparna Higgins and Joe Gallian at the Joint Meetings, the CURM (Center for Undergraduate Research) summer workshop by Michael Dorff, and occasionally American Institute of Mathematics or the Park City Mathematics Institute offer workshops on mentoring undergraduate students. Finally, maintain a file documenting your efforts. Such a file should include the names of students mentored, presentations given by students, papers written and published by students, and achievements of these students. Having one file listing all of your efforts will be convenient and helpful when applying for funding. Again, the idea is to build and document a track record. You will be more successful in obtaining funding if you have evidence of your efforts and results.

3. Funding resources at your own institution

In finding funds to support your undergraduate research efforts, the first place to start is your own institution. In a tight economy, there are not a lot of funds. But there are probably more funds available than you think. The first place to look is a university wide summer undergraduate research program that offers stipends for students to do research with a professor. Examples of such programs are the Summer Research Opportunities for Students at Denison University [3] and the Goucher Summer Science Research Program [4]. Not all institutions have funded undergraduate research summer programs and for those that do the amount of funding varies. Ask colleagues or your department chair if there is such a program at your own institution. Also, talk to colleagues who have received funding in the past to get more insight into the program. In applying to the program, having the file documenting your mentoring efforts will be beneficial in convincing the reviewers that you should be funded.

Another possible source of funding is the flexible funds that administrators sometimes have. Many mathematics departments or dean's offices have a small amount of flexible funds. These are generally not publicized, and you need to ask if such funds are available. You may be able to get a stipend for a student to do research. A more modest request such as partial funding for a student to attend a conference to present a talk or poster is more likely to be honored. Remember that receiving such small amounts of funds helps you build a track record that can be used to build a scaffold up to receiving larger grants. In 2000 the BYU Department of Mathematics asked and received some funds from the dean to start a one week Summer Math Institute which was like a pre-REU for BYU and non-BYU students. This led to Michael Dorff receiving a \$5000 MAA Tensor Grant a few years later and then a grant for an REU (Research Experiences for Undergraduates) site from NSF (National Science Foundation).

Some institutions offer start-up funds for new faculty. In mathematics, the amount of a start-up package is often small especially compared to chemistry or physics which could receive packages that are three-times as large. If you are a new hire at an institution, consider negotiating funds for undergraduate students to do research in your start-up package. You could ask for summer stipends for students or for travel support for students or for you to attend a conference. Even if you are unable to get such additional funds, asking for them sends a message to the administration that you are eager to do undergraduate research.

Many faculty are unaware that federal work-study can be used to provide funds for students doing undergraduate research. A faculty member can hire a student through work-study for assisting with their work (e.g., research). Federal work-study funds are awarded to students who apply for financial aid and ask for this on their FAFSA with awards being based upon family financial situation. Typical awards are \$2,000 for the academic year with the government covering 75% of this and the department covering the rest. Talk to your institution's director of financial aid and see what is available. Diana Ridgwell at Virginia Tech's CLAHS Undergraduate Research Institute has been successful in implementing this approach.

Another avenue is to work with alumni through your development office. A number of years ago Darren Narayan approached his college's development office and Alumni Network at RIT pitching the idea of finding alumni who would "sponsor a student" by covering the student's travel expenses to present research at a conference. Some development offices are looking for short-term funding initiatives in the \$500-\$1000 range in which the alumni can see the benefits of their donation within months rather than years. As a result of this, two students were funded. Since then, the program has grown with donations from alumni and other sources helping to support students to present at over 50 national conferences in the past ten years. When seeking support from alumni, the first step is to contact your development office. Most likely they will be willing to set up a meeting with you and a potential donor. This gives you an opportunity to pitch your idea. An even better idea is to include a student as part of the meeting. You do not have to ask specifically for the funds. You can just share your idea. For example you could offer to work with student(s) on research and take them to a national conference to present their results mentioning that such an experience will surely be a highlight of their undergraduate years and will help them get their dream job or gain admission into a strong Ph.D. program. After the meeting, the development director can follow up with the alumni and make the "ask". Finally, it is a great idea to invite the alumni to lunch so the students can share their experiences.

It is important to share your successes with undergraduate research with your department head and dean. Both BYU and RIT highlight undergraduate research in their newsletters and solicit requests from alumni to support undergraduate research. In addition both schools have made videos highlighting specific undergraduate research projects and students to share with alumni and donors as promotional materials.

4. Seeking funding outside of your institution

Having built and documented a successful track record in mentoring undergraduate students in research and having received some internal funding to support your efforts, you are primed for seeking outside funding. The three main sources for funding undergraduate research in mathematics are the MAA, NSF, and CURM.

Programs through the MAA include regional undergraduate conferences mentioned above, travel funds for students, Tensor grants, and NREUP. The travel grants [5] provide up to \$750 for undergraduate students presenting their work at MathFest or the Joint Meetings. Pi Mu Epsilon, the National Mathematics Honor Society, also provides up to \$600 in funding for students to present at MathFest (for more info see [6]). The MAA's Tensor Women and Mathematics grants can also be a resource for funding [7]. These grants are designed to encourage women to study mathematics and are up to \$6,000. You could propose a program around women and undergraduate research. As mentioned earlier, Michael Dorff did this with a pre-REU program at BYU.

The MAA's NREUP (National Research Experience for Undergraduates Program) [8] awards grants of up to \$27,500 to support one faculty member and at least four of students from underrepresented groups to do summer undergraduate research at the faculty member's institution. This program is an excellent way to expand your undergraduate mentoring and work with minority students who would benefit from a summer undergraduate research experience. Also, there have been several faculty who have received NREUP grants and then have expanded their efforts by receiving an NSF grant to host a 3 year summer REU at their own institution with an emphasis on working with minority students.

NSF funds proposals to operate a summer REU (Research Experience for Undergraduates) program [9]. Mathematics REUs typically run for eight weeks during the summer with 8-12 undergraduate students working in groups on research problems under the direction of a faculty mentor. A list of current REU Sites in mathematics can be found at [10]. If you have an existing NSF research grant, then you can apply for additional funding from NSF in the form of Research Experience for Undergraduates Supplements [11]. These supplements provide funding for undergraduate students to work on research with you.

Additionally, there are several NSF programs for increasing the number of students completing a STEM (science, technology, engineering, and mathematics) degree and grants in these programs can be used to fund undergraduate research. These programs include Louis Stokes Alliances for Minority Participation (LSAMP) [12], the Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP) [13], and the Mentoring Through Critical Transition Points in the Mathematical Sciences (MCTP) [14]. Examples of undergraduate research programs funded by one of these NSF programs include the Pacific Undergraduate Research Experience in Mathematics (PURE Math) [15], Long-term Undergraduate Research Experience (LURE) [16], STEPping up Undergraduate Research at Middle Tennessee State University (STEPMT) [17], and Positive Routes into Science and Mathematics (PRISM) [18].

A third major resource for funding is the Center for Undergraduate Research in Mathematics (CURM) [19] which is directed by Michael Dorff. CURM awards mini-grants of up to \$25,000 to support and fund faculty to do undergraduate research during the academic year with

their own students at their own institutions. Activities include a 3-day summer workshop to train faculty in doing successful undergraduate research and a spring research conference for students to present their work. The mini-grants provide a \$3,000 stipend for each student, a \$6,000 faculty stipend to reduce to faculty member's teaching load, and funds to travel to the summer workshop and spring conference.

Also, industry and business can be resources for funding. RIT has also connected with eBay and Eastman Kodak Company to receive both student projects and funding, and BYU has discussed seed grants of \$5,000 with Raytheon to set up research projects for students. At the start of RIT's program Darren Narayan reached out to a major airline and asked them to support two students in the form of travel vouchers. This worked well for several years and gave our program tremendous visibility. Another idea is to request similar support from the hotel industry that may help with lodging expenses. A reasonable place to start is to contact customer service departments and asking for a contact person for sponsorships. It would also be worthwhile to see if your college or university has alumni in either the transportation or hotel sectors. They might be able to provide valuable support. It is best practice to work with your development office and alumni relations personnel.

There are other organizations that have programs that fund activities related to undergraduate research. These include government organizations such as National Security Agency (NSA), National Institutes of Health (NIH), U.S. Department of Education, Department of Defense (DOD), and Department of Energy (DOE). Also, there are national laboratories such as Lawrence Livermore National Laboratory, Oak Ridge National Laboratory, and Sandia National Laboratories.

Colleges and universities often have resources to help you search for funding opportunities. The University of Illinois Researcher Information Service (IRIS) contains all of the federal government funding solicitations as well as thousands of active solicitations from private foundations, and the Foundation Center carries information on approximately 20,000 foundations that are actively seeking proposals as well as those that do not advertise but accept proposals in their areas of interest. Also, Grants.gov is an online resource to search for funding opportunities available through the federal government.

5. Some tips on writing a strong proposal

When seeking external support, it is essential to have a very strong proposal. Competition to receive a grant is strong. A successful proposal is clearly written and consists of both a great idea and a track record demonstrating that the PI and supporting team is capable of succeeding.

In writing a proposal it is a good practice to secure a copy of a previously funded proposal in order to see what that proposal contains. Most funding resources list individuals who have received funds. Look through that list and see if you know any of the recipients. If so, contact them and ask if they would be willing to share a copy of their proposal. Even if you do not know any of the recipients, contact some of them. This may be intimidating, but it can be very helpful. Since a funded proposal consists of a great idea and a track record,

many PIs are not worried that you would copy their proposal. The authors have received several emails from individuals we do not know asking us to share our successful proposals, and we have done this. Also, make sure that several times in the proposal you address the reason why it should be funded. Remember that the other proposals will also be presenting a case why they should be funded. Your proposal should stand out in a positive way. In addition, have someone, who is not involved with the project, read through the proposal before submitting it. Get feedback on the writing. Is it clear? What is the main idea they get from reading it? Are there any typos?

When working on a proposal leverage funds and combine funds from various sources to make your budget more attractive. At times, a funding agency will not be able to give you all the funds you want or there may be restrictions on how you can use the funds they give you. Try combining funds from several sources. For example, when Michael Dorff applied for an NSF REU grant, he knew that he could get funds from his university to support BYU students in the REU. So in the NSF grant proposal, he wrote that if NSF funds 9 students for doing research, BYU will fund an additional 4 students. In another example, Darren Narayan applied for an NSF grant and his institution RIT pledged support for one student and one faculty member in each of the three years of the project. In doing this, remember to include a letter of support from the other funding source, stating that they will do this.

6. Conclusion

Start small by building a successful track record of mentoring students in research. Make sure you document your efforts. Then look for funding opportunities at your own institution. As you do this, you will gain experience and expertise that will assist you in securing larger grants from external resources. Remember that while many sources of funding exist, they are often competitive. Keep trying and seek feedback if your proposal is not funded. And be creative. Look for new opportunities to fund your undergraduate research program.

References

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