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Institutional support for undergraduate research

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Institutional support is critical for establishing and maintaining an undergraduate research program. This paper discusses some of the challenges that one may encounter when seeking to institutionalize undergraduate research, including budget and personnel issues. It provides various views and ideas from schools that have been successful in securing institutional support for undergraduate research, and makes some suggestions of rationales for effectively arguing on behalf of undergraduate research.

This paper is based on ideas generated at a breakout session at the 2012 national conference on Trends in Undergraduate Research in the Mathematical Sciences. Additional resources for a more in-depth discussion of the ideas presented in this paper are also provided.

1. Introduction

Institutional support is critical for establishing and maintaining undergraduate research (UR) programs in all disciplines. In recent years, we have seen many short- and long-term UR programs flourish across the nation. In addition to approximately 75 federally funded NSF–REU sites and the NSA Director's Summer Program, there are many programs supported by the National Science Foundation in which UR plays an important role: the Research Experience for Undergraduates Supplement Program, the Science and Talent Expansion Program (STEP), the Mentoring at Critical Transition Points program (MCTP), the Undergraduate Biology and Mathematics program (UBM), the Enhancing the Mathematical Sciences Workforce in the 21st Century (EMSW21), and the Louis Stokes Alliances for Minority Participation program (LSAMP).

Even with these federally funded programs, there are not nearly enough UR opportunities. We know that many of the NSF-funded summer REU sites accept nine to twelve students but receive hundreds of applications. Further, given the

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current economic conditions, how long these programs can be sustained is not certain.

As a result, the 2012 national conference on Trends in Undergraduate Research in the Mathematical Sciences (TURMS) challenged participants to tackle two major themes:

(a) How to sustain REU programs after the federal money runs out.

(b) How to create institutional UR with no federal money at all.

Here we will discuss three aspects of securing institutional support for UR: challenges to address, examples of ways that schools have been successful in securing support, and suggestions/rationales for arguing effectively on behalf of UR. The ideas presented here were generated at a breakout session designated for this purpose at the 2012 TURMS conference.

2. Challenges for institutional support for UR

Arguments one might encounter when seeking to institutionalize UR can be divided into two categories: budgetary issues and personnel issues. In [SUR 2006; Davis et al. 2008], the authors give an excellent discussion of both categories, particularly about issues related to faculty time. Here, we make a few additional brief comments.

Budgetary issues. Convincing a dean/provost/president to allocate continuing funds to a new program can be difficult, but this is the ultimate goal in establishing UR as a program that students and faculty can count on and build upon. One of the often-mentioned challenges to securing institutional support for UR, particularly at larger institutions, is the fact that federal grants for UR bring little or no overhead. Administrators are therefore reluctant to allocate resources to programs that support UR. This challenge, however, is not as prevalent at small liberal arts colleges, which gain visibility by establishing national REU programs. In addition, many federally funded summer REU programs bring students from outside of the institution where the REU program is conducted, and institutions are reluctant to invest in programs that include students from other schools.

Personnel issues. UR brings several direct and indirect benefits, and faculty should advocate its significance to their department and university, particularly its benefits to faculty. First and foremost, faculty enjoy an intellectually stimulating environment where diverse perspectives and exchange of ideas happen. Getting undergraduates involved in research, both disciplinary and multidisciplinary, is one way to cultivate and promote this type of environment across departments, colleges and the university. UR may create the opportunity to renew and/or reinvigorate a program, and can be a path for internal and external recognition. The pleasures of passing knowledge

and witnessing a student's intellectual growth are lifelong benefits faculty can reap from getting involved in UR.

Faculty can benefit from UR in specific ways as well. A faculty member may get credit for tenure and/or promotion if research conducted in collaboration with undergraduates leads to peer reviewed publications and conference presentations. Mentoring undergraduates in research may count as independent or directed studies and can be part of the faculty's teaching load. Getting involved in UR can help faculty in securing grants as many of these encourage involving undergraduates in the proposed program. Getting involved in multidisciplinary UR can create a venue for faculty-faculty as well as faculty-student collaboration across a variety of disciplines. Faculty may also use the UR experience to improve their teaching and initiate a new area of research in the scholarship of teaching and learning.

Even when the budget is not an issue and there is clear evidence of the benefits of UR, it has been difficult to implement UR across all institutions. One major challenge is enlisting faculty to establish and sustain a UR program. Anyone who has mentored UR in mathematics knows that it is time consuming and requires careful thought on student selection as well as finding problems that are appropriate for undergraduates. As a result some faculty may choose not to get involved. At some institutions, junior faculty invest their time in their own research and writing proposals to secure external grants as these are the major accomplishments that count towards faculty rewards. At other schools, some administrators view UR as a distraction from classroom teaching. Finding a balanced way to compensate faculty for doing UR will help alleviate this challenge.

In the next section we will show that some schools have found ways to address these challenges.

3. Ideas from schools that have been successful in securing institutional funding

We remain convinced that UR programs in mathematics can work at all types of schools — large R1 institutions, comprehensive masters, small liberal arts — but what works at one institution may not work at another. That being said, adapting ideas from schools that have been successful in getting institutional support for UR is a good way for schools to begin a program or increase opportunities. Below is a summary of ideas that have worked in at least one school. For each item, we give at least one example of a place where the idea has been implemented successfully, without attempting to give a comprehensive list.

(1) Look for university-wide programs with wider purpose for which mathematics UR might be a part. At Michigan State University (MSU), some faculty take advantage of the MSU Professorial Assistantship Program to get students involved

in UR. (See MSU's Honors College brochure *HC Connections*, available online at http://honorscollege.msu.edu/_documents/HConnections_2011.pdf.) Each year, approximately 200 freshmen are appointed as professorial assistants (PAs). The PAs work with regular members of the faculty on tasks directly related either to scholarly research or to innovative teaching. Students whose academic records place them in the top one percent of entering college freshmen nationwide are offered the opportunity to participate in the Professorial Assistantship Program. The PAs work an average of eight to ten hours per week and are paid a stipend of approximately $2500 for the academic year. Those who perform satisfactorily are reappointed for a second year at a higher stipend.

(2) Look for other programs on campus with a budget for which mathematics UR might fit the goals. MSU has a residential college system where students in a particular field of study (like sciences or social sciences) live together and take classes together in the first two years. Each college has its own dean and its own budget that can sometimes be used for UR funding.

(3) Build internally to support external funding. In other words, use obtaining external funding as an incentive for president/provost/dean to provide new funds from internal sources for UR. At a large R1, this might be dependent at first on finding external funding that provides some overhead to the school. For a small liberal arts college where the amount of indirect cost money received is often less important than the total amount of external funding, this incentive may have more impact. Middle Tennessee State University piggybacked on significant funding for UR from an NSF STEP grant to convince its president to fund a center with additional recurring funds from the university for UR.

(4) Work with the development office and alumni. Illinois State University tied a large donation from an alumnus designated for scholarships in the sciences to a scholarship for UR students. Some schools prepare a nice brochure describing such projects to share widely.

(5) Pay attention to smaller grant opportunities. The Rochester Institute of Technology got travel vouchers from JetBlue for students to be able to make conference presentations. The University of Richmond has funding from the Virginia Foundation of Independent Colleges for one student researcher in the summer that can sometimes be used to fund a student in mathematics.

(6) Make UR part of the curriculum or at least part of a course. At Middle Tennessee State University, if students engaged in UR in the summer are receiving course credit, the faculty mentor can receive a small stipend from summer school funds. When faculty members supervise individual projects as independent studies or some other way that is not a regular course, they are more often than not expected to

do this in addition to their regular course load. Some schools have successfully addressed this issue by including UR in the design of their curriculum.

(7) Develop relationships with industry. The Center for Industrial Mathematics and Statistics (CIMS) at the Worcester Polytechnic Institute, created as a mathematical resource to industry that faces highly technical problems involving sophisticated mathematics, has opportunities for UR. The Rochester Institute of Technology is another example of a school that has found opportunities for UR by working with industry.

The session participants also noted that schools, especially those that have active UR programs, need to form partnerships with other institutions that do not. A place where this is especially needed is community colleges, where we have a large population of mathematics students and very little current institutional support or a critical mass of faculty members involved in research.

4. Arguing effectively on behalf of UR: suggestions and resources

Beyond being creative in finding sources of funding, most faculty who are working to establish, sustain, or expand a UR program find themselves in the position at some point in time of asking for funding. Below are some ideas generated by others who have been in this position.

(1) Convince the dean/provost/president that UR will benefit the university by dramatically affecting the education of the students involved. With research experience, students will:

- gain self confidence;
- improve writing and speaking skills;
- learn teamwork;
- develop an understanding of what professional mathematicians do;
- be more likely to enter graduate school [Petrella and Jung 2008; Lopatto 2007];
- be more likely to receive admission into a better graduate school;
- be more likely to perform better research in graduate school;
- be more likely to earn a PhD degree;
- be more likely to receive a better job offer;
- be better prepared to manage projects in their future profession.

Numerous studies that quantitatively assess the great impact of UR experiences on the professional formation of students can be cited. For example, see [Petrella and Jung 2008; Thiry et al. 2011; Gregerman 2008; Hunter et al. 2007; Lopatto 2007;

Carter 2011; Hensel 2012; Kinkead 2010; Boyd and Wesemann 2009; Karukstis and Elgren 2007; Kinkead and Blockus 2012; Karukstis and Hensel 2010].

(2) Whenever possible, invite top administration officials (dean/provost/president) as well as alumni and potential donors to UR presentations, to build institutional support and ensure top officials are aware of students' accomplishments.

(3) Advocate the importance of UR as a tool to close the achievement gap among students of different ethnicities. (See, for example, [Boyd and Wesemann 2009] or [CUGESEWP 2011].)

(4) Convince the administration that UR inevitably competes with part-time external jobs: monetary resources are required to recruit the best students and allow them to engage in research without the burden of a part-time job on the side. In particular, a research opportunity without funding for the student significantly limits the participation of students who rely heavily on financial aid. One often low-cost way to help students get involved in UR is by offering them free or reduced-cost summer housing.

(5) If possible, bring up the issue of internal funding for UR in the context of accreditation discussions. With accreditation issues fresh in their minds, administrators might be more willing to invest funds in extracurricular activities that improve the delivery of undergraduate education (such as UR). (See [Hensel 2012].)

(6) Establish a mentoring system whereby faculty members with experience in leading UR (and obtaining intra- and extramural funding to support it) coach their junior colleagues on effective bargaining strategies with administrators.

(7) Convince the development office (or any other office in charge of relationships with prospective and current donors) of the strong relationship between participation in UR during college and future success in the market place. Donors like to invest in initiatives that directly affect students' success rate in finding top jobs.

(8) Meet with a dean/provost/president or approach the sponsored projects office directly and discuss possibilities for cost-sharing and/or partial overhead return for extramural funding dedicated to UR. Useful forms of support include both cash (e.g., funding to support additional students, materials and supplies, pedagogical equipment) and in-kind (e.g., time release for faculty). The latter might be easier to obtain and is of critical importance in finding motivated faculty willing to supervise UR. This strategy goes beyond support of UR-only grants. For example, Cal State Fullerton offers time release (on a competitive basis) for faculty submitting extramural grants; since the dean is particularly appreciative of UR, there is incentive for faculty to include funding for UR in any research grant in order to become more competitive on their released-time application.

(9) Convince the administration that support of the faculty involved in UR is absolutely essential for the success of the program. This support may come in different forms, but will have to include recognition of efforts spent on UR in personnel cases (tenure, promotion, etc.). (See [Hensel and Paul 2012].)

(10) Convince the administration to establish a campus-wide centralized office for UR to maximize the visibility of the initiative and hence the impact on the reputation of the institution. Explain that most highly successful undergraduate programs are associated with a central office of UR, which oversees campus-wide UR activities, including but not limited to on-campus research symposia, summer research, student workshops, mentorship training, and disbursement of funds for student travel. Some UR offices award internally or externally funded summer research assistantships to students and/or to faculty. Such a center would retain all information on participating students, and allow effective statistics on impact, success in the market place, etc. Even more importantly, a centralized office would identify and coordinate potential multidisciplinary projects, and act as a unified "lobbying center" for intramural and extramural funding support. The establishment of a designated position for a UR program director provides a clear statement of the importance and expected potential of the UR enterprise on a campus.

5. Additional resources

Several resources exist that have a more in-depth discussion on ideas presented here. Three excellent places to start are the Council of Undergraduate Research (CUR) website (http//www.cur.org/publications/publication_listings), the *Report of the MAA committee on the undergraduate program in mathematics*, available at http//www.maa.org/cupm/CUPM-UG-research.pdf, and the MAA column *Resources for undergraduate research in mathematics*, which can be found online at http//www.maa.org/columns/Resources/resources.html.

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