AC 2009-542: IGERT FUNDING AND THE INSTITUTIONALIZATION OF INTERDISCIPLINARY GRADUATE EDUCATION

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IGERT Funding and the Institutionalization of Interdisciplinary Graduate Education

Abstract

Interdisciplinary graduate education is key to the preparation of tomorrow’s engineers, researchers and faculty. The U.S. National Science Foundation’s Integrative Graduate Education Research Traineeships (IGERTs) provide funding to train students in interdisciplinary science and engineering. These five-year federal grants fund student traineeships, travel, and some supplies, but not equipment, space, or faculty lines. According to the 2008 RFP, “The program is intended to catalyze a cultural change in graduate education, for students, faculty, and institutions, by establishing innovative new models for graduate education and training in a fertile environment for collaborative research that transcends traditional disciplinary boundaries.” Therefore, if interdisciplinary graduate education innovations are to be institutionalized, additional provisions must be made by the university faculty and administration. To better understand the strategies employed to institutionalize changes initiated through a limited source of funding, we conducted a qualitative analysis of the successful proposals of 134 IGERT grants. Each proposal was selectively coded for plans to institutionalize the interdisciplinary program. The most commonly cited strategies included new certificate or degree programs, commitment of space and/or faculty lines, and cost-sharing with existing departments or research centers. Several proposals did not address sustaining the program beyond the initial funding period. These findings support an argument for a more inclusive approach on the part of universities and faculties to supporting interdisciplinary programs such as IGERT, built on the realization that a comprehensive approach to sustainability is necessary in order for interdisciplinary change to become permanent at an institution. This broad survey of institutionalization plans complements an ongoing in-depth study of the impact of IGERT on interdisciplinary activities at a few specific institutions.

Introduction

Innovation in graduate education is key to the preparation of tomorrow’s engineers, researchers and faculty. Often, innovations are prompted or supported by outside sources of funding, such as grants and fellowships that allow for new systems or foci of research to be explored. The U.S. National Science Foundation (NSF), for example, supports several initiatives, including Integrative Graduate Research Education Traineeships (IGERT). IGERT money is used to support graduate student trainees in interdisciplinary research initiatives. Specifically, according to the 2008 RFP, “The program is intended to catalyze a cultural change in graduate education, for students, faculty, and institutions, by establishing innovative new models for graduate education and training in a fertile environment for collaborative research that transcends traditional disciplinary boundaries.” Unfortunately, after start-up grants and fellowship programs like IGERT run out, many innovations in higher education are forced to scale back or are abandoned altogether. Sustaining innovation beyond preliminary funding requires careful consideration of possibilities for institutionalization.

The purpose of this analysis is to determine what kinds of efforts at institutionalization of innovation have been recently proposed in initial plans for graduate education. Specifically, we...
examined 134 funded NSF IGERT proposals for 120 unique IGERT sites (14 were renewal proposals), and examined their proposed organizational structures and any university support or explicit plans for sustaining the project beyond the five-year funding period. Our analysis of the proposals was guided by the following questions, which are more thoroughly treated in the sections below:

1. What proportion of successfully funded interdisciplinary graduate education proposals specifically addressed sustaining the program after the funding period?
2. What were the most commonly cited strategies for sustaining the program beyond initial funding?
3. Which unique strategies for sustaining the program beyond initial funding could inform future sustainability efforts?

IGERT is the flagship funding program for the U.S. National Science Foundation’s Division of Graduate Education, and widely regarded as a premiere source of innovation in interdisciplinary graduate education, particularly across a range of institutions. Although this study is limited to an examination of funded IGERT proposals, our findings suggest strategies that may be implemented more generally to institutionalize innovation in engineering education, particularly at the graduate level.

**Literature Review**

Innovation in higher education can take on a number of forms. It can be administrative or curriculum related, can affect students directly or indirectly. No matter its specific context, innovation is important for higher education because it allows for students, faculty, and administrators to support new research and more efficient teaching methods. Each year, new studies are published, praising the benefits of innovative higher education or urging support for it\(^1,3,7-15\). Engineering education in particular has historically embraced innovation, even if it has focused on the undergraduate level\(^16\).

However, no matter how well-funded an initiative is from the outset, in order for innovation to have lasting effect at a university it must eventually focus on long-term sustainability\(^17\). Just as innovation itself can take on many forms, so can the support structures which allow for the adoption and institutionalization of change. For example, millions of dollars worth of grants and other forms of institutional support to programs and students are awarded annually in an effort to further the progress of graduate education or interdisciplinary work more generally\(^5,18\). The process of enacting a cultural change in university communities can be arduous and politically charged\(^19\). Change is usually conceptualized as a process with multiple stages, and people are usually at different stages, requiring different arguments and resources\(^20\). Other problems at any level can cause roadblocks for institutionalizing change\(^21-24\). These include barriers to faculty, students, and administrators\(^25\). According to Gumport and Snydman\(^26\), the organization of universities is both programmatic and bureaucratic. As they see it, “…universities and colleges both reflect and reconstitute classifications of knowledge and in so doing establish categories of expertise and knowledge worth knowing”\(^26\). The popularity of a new idea may also be at issue, as innovations that are well-liked are more likely to be
integrated. The first step to overcoming such barriers is recognizing that such difficulties are real and preparing to meet them.

According to Clark et al., “Institutionalization, most broadly conceived, is the process whereby specific cultural elements or cultural objects are adopted by actors in a social system.” On one level, it can involve the institutionalization of artifacts which persist after initial funding is ended. These may include courses, certificate or degree programs, labs, collaborative relationships, and new curriculum, among other things. Additionally, sustaining innovation in higher education often requires financial support. New courses or degree programs may need faculty and staff to oversee them, and graduate students studying new areas of research may also need assistantship funds or resources for tuition waivers. Often, new programs are left with the responsibility of finding new donors or becoming self-sustainable. Furthermore, some studies suggest that cultural innovations are necessary, and that innovations that are institutionalized through culture, policies, or practical reform have higher rates of success. “Cultural innovations” are changes to the way that a group thinks or acts. In this case, the changes may need to be made in order to realign the culture of the department(s) or program with new interdisciplinary goals.

The IGERT RFP clearly states that the original grant funding is to be a catalyst for change. Because sustainable change requires real effort, IGERTs, like other innovative programs in higher education, need to think creatively about the barriers to long-term sustainability. Therefore, once the original funding has run out, programs must have a plan for institutionalizing or sustaining desired outcomes, processes, and other artifacts of the innovation. Successful sustainability and institutionalization of funded innovations requires careful thought and planning, and early consideration of potential problems or opportunities for facilitating cultural and organizational change allow time for adjustment. Our research suggests that many PIs anticipate such issues in their original grant proposals (this was even more common among renewal grants). As shown in the findings below, plans for sustaining innovation from IGERT grants range from vague statements of university commitment to highly detailed plans for alternative funding and the long-term adoption of new courses, degree programs, and/or processes. These findings are consistent with a recent NSF draft report which states that IGERT programs ought to
develop short-term, intermediate-term and long-term measures of success of interdisciplinary research. The categories of effects should encompass internal effects on pedagogy, the structure of academia, and developing a diverse workforce in science and engineering, as well as external effects on industry, society (societal problems) and policy-makers.

While an analysis of IGERT final reports may have been more beneficial to this study, because the program only began in 1999, most IGERT programs are still underway. Therefore, we determined to rely (at least for this initial analysis) on the proposals themselves, and focus on the kinds of strategies envisioned by the individual programs from the beginning.
Methods

This study is an analysis of 114 successful NSF IGERT proposals. In the summer of 2008, one author contacted the past and present PIs of the 195 IGERT awards with start dates from 1999-2006, using the public NSF awards site to locate awards and contact information. Ultimately, 134 responded by submitting all or part of their proposals for our review. After an initial review of several complete proposals, we decided to isolate two required sections of the proposals for the purpose of this analysis (only 114 of the 134 proposals received included the entirety of both sections). These sections dealt with organization and management, and performance assessment (because the proposals span nearly a decade, the exact titles of these sections changed over time, although the required content remained largely the same). Once the relevant sections were isolated, one author coded them into two broad categories with NVivo qualitative analysis software. These categories were “specific strategies” for support and “vague commitments” of support of program innovations that were part of the IGERTs themselves. The broad code of specific strategies was further subdivided to isolate the fundamental strategies. The results of this coding were then used to address the specific research questions, which are stated in the introduction to this paper.

Findings

Question 1: What proportion of successfully funded interdisciplinary graduate education proposals specifically addressed sustaining the program after the funding period?

The 114 proposals we reviewed offered a wide variety of possible strategies for sustaining some aspects of the IGERT programs (education, courses, mentoring, research, etc.) past the expiration of initial funding from the NSF. Altogether, 26 programs (22.8%) mentioned plans for sustaining or continuing the program. Five of these (19%) were renewal proposals. Of the 9 renewal grants we analyzed, 5 (or 56%) mentioned sustaining the program beyond the funding period. Proposals were more likely to specifically mention efforts or expectations of sustainability if they were written in the last six years (see Figure 1).

![Figure 1. Number of Proposals Analyzed and Number Mentioning Institutionalization.](image-url)
Apart from sustainability, most of the proposals included some mention of the need for institutional support in addition to NSF funding. Specifically, 108 of 114 proposals (95%) mentioned specific plans for supporting the IGERT. However, many of these were only brief, cursory mentions without any allusion to a real plan for action. For example, one proposal stated:

Active engagement at all levels—from IGERT fellows to university administrators—will ensure that the key features and innovations of the program will become part of the way we train and educate.

Another simply said: “The [Name] IGERT program will allow powerful synergies with existing campus and off-campus programs.” Vague or unclear statements such as these suggest some desire for sustainability, and an awareness on the parts of the PIs. However, they also belie a lack of concrete planning regarding institutionalization or sustainability. It ought to be noted that although the RFP from the NSF establishes guidelines for proposals (which include a section for institutional support), no specific instructions are given as to the nature of this content. This lack of expectation explains the wide range of detail in support listed or suggested by PIs.

A minority of the proposals mentioned specific strategies for supporting or sustaining IGERT plans apart from NSF funding, including specific sources and amounts of funding. Many of these were actually seeking renewals of IGERTs already in place, and their specific plans suggested that they had learned what was necessary from experience and were looking forward toward the future. One renewal proposal said:

The Dean of [academic program #1] and the Dean of [academic program #2] have both enthusiastically endorsed this proposal. They agree that [both groups previously mentioned] will provide:

- Support for all faculty participation, including software and curriculum development, except for one month of the PI’s salary.
- Support for all courses involved in the program.
- Administrative and clerical support for all aspects of the program.
- Support for external speakers in the seminar series.
- Support for undergraduate participation and research.

In addition, each participating department will assist in assessing the progress of each student on a semester basis, and will also participate in assessing the program itself. We note that the NSF grant covers only part of the tuition, stipend, and overhead. In some cases the department and in some cases other sources will be used to equalize the NSF stipend to the stipend other students are receiving, and cover tuition costs.

Another said:

An interdisciplinary Ph.D. program in the Graduate School is under consideration. This IGERT program will form an institutional nucleus around which these disparate certificate programs can evolve into a meaningful program of
interdisciplinary education in environmental science and policy. We are committed to using this IGERT in conjunction with the [Name] IGERT, to develop a critical mass of programs and faculty that will accelerate the shift toward interdisciplinary graduate education at [Institution]. We propose to create institutional changes that will reduce administrative impediments to interdisciplinary learning and research, promote diversity, and foster cross-campus graduate educational opportunities. These include common course numbering with appropriate credit given to faculty who are team teaching (see further explication below), streamlining the co-chair process through the Graduate School, support to a campus wide [Institute], and strong support from faculty to the Graduate School for the implementation of an interdisciplinary Ph.D.

Specific plans such as these were more common among renewal grants, and also generally coincided with high levels of support from university administration (also stated, as above, in dollar amounts and as support for programs).

**Question 2: What were the most commonly cited strategies for sustaining the program beyond initial funding?**

Of the specific ideas laid forth for sustaining IGERT programs, the most commonly cited needs were for (1) support from other university programs (mentioned in all of the proposals), and (2) funding from outside sources (mentioned in 16 proposals, or 14%). Many of these proposals spoke of a “vision” or “goal” for sustainability, without including concrete plans. For example, one proposal stated:

We envision a program that continues to be sustained through an increasing spectrum of partner institutions and external research grants in [specific] areas.

Another said:

We expect that enough momentum will be gained to attract new funds from regular research grants to support a cohort of students as research assistants under the proposed theme.

Other proposals are more specific, and offer details of their plans for sustainability. One proposal offers the following account of where funds will come from and to what use they will be put:

Based on the success of the program, we will also seek private foundation sources of support to sustain the stipend and tuition fellowships for the period beyond the NSF funding, as an alternative funding mechanism.

A few proposals went so far as to list specific partners in industry who were already on board with supporting the existing IGERT program after NSF funding was finished.
Besides the need for support both from inside and outside of the university, proposals mentioned other strategies that would sustain the IGERT program on a day-to-day basis (though not necessarily beyond the NSF funding period). These included organizational or administrative concerns. Thirty-two proposals (28%) specifically mentioned that the IGERT would be facilitated by or housed in a center—either an existing center, or one to be created once IGERT funding was secured. Beyond this, all 114 of the proposals included some mention of one or more departments that would support the IGERT. Some specified ways in which workload and administrative duties would be shared between departments, and others suggested that a single existing department would provide the central administrative and organization support for the IGERT. This included support for students, and new courses, certificates, or degree programs.

As mentioned previously, most of the proposals did not mention sustainability at all. Instead, they focused on how the investigators would make the IGERT successful during the original NSF funding period, and emphasized how they would make the most of the opportunity through university matching funds and other methods.

**Question 3: Which unique strategies for sustaining the program beyond initial funding could inform future sustainability efforts?**

Perhaps the most unique strategy given for sustaining IGERT programs beyond initial periods of funding was entrepreneurship. A few proposals mentioned that their students would do research that would appeal to a specific sector of business or industry, and therefore would attract funding and build sustainable relationships (leading to possible internships and future job placement, or other collaborations). For example, one proposal states:

We are optimistic that there will be increasing recognition that the innovative approach of [IGERT program name] and similar programs must replace the narrow, traditional training programs in conservation and resource management, and that funding opportunities will emerge from the new interdisciplinary teams that materialize.

In a similar vein, another proposal said, “We anticipate a membership agreement with industry affiliates before the end of the 5-year NSF funding, thus providing a baseline level of funding for maintaining the program.”

Another proposal went even further, naming an international company (the largest in the world in its particular field) which had committed significant funds to the program. In a renewal proposal for this IGERT, they explained that these funds “provided fellowships to graduate students who were selected from research proposal competitions,” and described how these industry fellows “conduct a summer internship at [industry partner], working with staff [specialists].” They also noted that this industrial support would continue through the renewal period, if awarded.

Other strategies provided were not quite as unique, but they provided solid ground for concrete planning. For example, one particularly concrete strategy suggested by several (n = 98
or 82%) of the proposals was the integration of new courses into the curriculum. Courses, as artifacts of the IGERT program, would remain in place even after other program structures had disappeared. Additionally, new courses, once implemented, require little effort to sustain. One proposal said, “Upon cessation of the IGERT funding, and upon favorable review by Fellows and faculty, we will retain the proposed structure for training and coursework.” Many other proposals listed similar commitments to maintaining innovations in the classroom and curriculum after the IGERT funding period had ended.

Conclusion

Innovation is imperative to the advancement of graduate education. Funding programs, such as the NSF IGERT program, allow for universities to develop new ways of thinking about and enacting education and research training at the graduate level. The IGERT program specifically provides funds for students to pursue an integrative learning experience, and is meant to be a catalyst for change in existing university programs. Funds such as these are limited, however, and programs must plan ahead for how to make innovation sustainable after the initial funding period has expired.

This paper has outlined a number of strategies planned by successful IGERT proposals to make changes and innovation gained during IGERT funding sustainable after that funding period has ended. Our analysis demonstrates that while most IGERTs are interested in finding support for their programs (either within or outside of the university), many do not make specific plans for continuing the programs when the funding has run out. Of the programs that have planned for sustainability, many offer non-specific goals for funding from industry, or other university mechanisms of support. A few proposals mentioned specific or detailed plans for how to continue to sustain innovation gained through the IGERT program. These plans often built off of existing relationships with industry or other funding partners.

As per the findings of this research, we encourage not only concentrated efforts toward innovation in graduate education (including IGERT programs and other opportunities), but also concrete plans for making those changes sustainable. If students are benefited by the changes that are initially implemented during a wealth of funding, other students ought to also be allowed similar opportunities—even if funding must come from other, more inventive sources. As mentioned above, these can include industry partners, government grants, collaborations with other universities or research programs, or administrative or other support from the university. When sustainable innovations become entrenched in the structure or practice of a program, they can be built upon and expanded. However, plans for keeping hard-won innovations in place must be made deliberately and early so as to be most effective.

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