

Executive Summary

This report summarizes findings from an evaluation of the impacts of the National Science Foundation's (NSF) Integrative Graduate Education and Research Traineeships (IGERT) program. Through support of interdisciplinary graduate education programs in Science, Technology, Engineering, and Mathematics, the IGERT program aims to educate U.S. Ph.D. scientists and engineers with the interdisciplinary backgrounds, deep knowledge in chosen disciplines, and technical, professional, and personal skills to become, in their own careers, leaders and creative agents for change. IGERT also aims to catalyze a cultural change in graduate education by establishing innovative models for graduate education and training in a fertile environment for collaborative research that transcends traditional disciplinary boundaries. The IGERT program strives to facilitate diversity in student participation and preparation, thus contributing to the development of a diverse, globally-engaged, science and engineering workforce.ⁱ

A program evaluation conducted by Abt Associates Inc. examined IGERT program impacts on recruitment, students, faculty, and institutions, using surveys and interviews with IGERT participants and a comparison group of non-IGERT individuals. IGERT participants were drawn from a sample of participating departments in projects funded in 1998, 1999, or 2000. The comparison sample consisted of departments identified by IGERT department chairs as peer departments with whom they competed for graduate students. This enabled the construction of a comparison group that accounted for academic quality and provided a match for every IGERT department included in the study. Surveys were sent to IGERT PIs, department chairs, faculty and doctoral students, and to non-IGERT department chairs, faculty, and doctoral students. Resulting sample sizes were large enough to produce a level of precision such that proportions estimated from the full sample would have confidence intervals of plus or minus five percentage points or less. Survey response rates ranged between 72 and 94 percent. To provide data on institutional contexts, university administrators from IGERT and non-IGERT institutions were interviewed.

Overall, the study found that the IGERT program has had a measurable impact in altering the graduate educational experiences of participating students, supporting faculty engagement in interdisciplinary teaching and research, and advancing interdisciplinary graduate education within host institutions. Detailed findings related to the program goals of educating students, catalyzing cultural change, and promoting diversity are outlined below.

Educating Ph.D. Scientists and Engineers

NSF expects that IGERT projects will educate students to work in an interdisciplinary environment while being well grounded with depth of knowledge in a major field. The IGERT graduate experience should contribute to the professional and personal development of students and equip them to understand and integrate scientific, technical, business, social, ethical, and policy issues to confront the challenging problems of the future. Students should receive experience relevant to both academic and nonacademic careers, and be encouraged in developing an international perspective.

ⁱ Integrative Graduate Education and Research Traineeship (IGERT) Program, Program Solicitation, NSF 05-517.

IGERT projects have successfully developed new educational experiences for students in all of these areas. IGERT students receive more extensive interdisciplinary training than non-IGERT peers, but maintain depth of study in their chosen fields. IGERT students consistently report greater opportunities to learn about other disciplines, interact with faculty and students from other disciplines, and work on projects involving multiple disciplines. They are better prepared to work in multidisciplinary teams and communicate with people outside their own fields. At the same time, according to both faculty and students, the level of in-depth preparation in students' fields is similar for IGERT and non-IGERT participants.

The IGERT experience provides students with significantly broader professional and personal skills for their future careers. IGERT students receive greater training in teamwork, presentation, and communication skills, and are twice as likely as non-IGERT students to have received formal training in research ethics, an area emphasized by the IGERT program. Participation in the IGERT program provides broader career exposure as well, with IGERT students reporting more opportunities to conduct off-campus internships and interact with people outside their home institutions and outside academia. Overall, the educational experiences reported by IGERT students are quite different from those reported by non-IGERT students, and as a result, IGERT students report feeling better prepared for their future professions, as measured by the data collected, than non-IGERT students.

Catalyzing a Cultural Change in Graduate Education

A longer-term goal for the IGERT program is to catalyze a cultural change in graduate education, resulting in faculty and institutional support for interdisciplinary graduate education. IGERT has been successful in promoting a fertile environment for faculty to engage in interdisciplinary teaching and research. While interdisciplinary activities are common among all faculty surveyed, IGERT faculty and department chairs report an additional shift towards more interdisciplinary work as a result of IGERT participation. IGERT faculty members team-teach with colleagues outside their departments and mentor graduate students from other disciplines in greater frequencies than non-IGERT faculty members. A majority of IGERT faculty members report that participating in IGERT has enabled them to teach a greater variety of students and incorporate a broader range of topics in courses. With respect to interdisciplinary research, more IGERT faculty publish and present research in journals and conferences from outside their home disciplines, and are more likely to work on research projects and co-author publications with colleagues from other disciplines.

According to the IGERT faculty respondents, participating in the program has been a stimulating professional experience, one to which they are willing to devote substantial time with little direct compensation while generally maintaining other departmental responsibilities. Large majorities of the faculty members feel that IGERT enabled them to establish work with colleagues in other departments and exposed them to new ideas. About half of the faculty members reported learning new research techniques, exploring research that would not otherwise be funded, or being in a better position to win new grants as a result of IGERT. These outcomes suggest important benefits for faculty participating in IGERT that have the potential to increase support for interdisciplinary approaches to graduate education.

Findings from the evaluation suggest that IGERT projects are helping advance interdisciplinary graduate education in their institutions. Project PIs report that their projects have led to policy changes for interdisciplinary coursework and teaching, revised degree requirements, and created new degrees and certificates, as well as increased university support for interdisciplinary education in

general. Participating department chairs point to IGERT grants as stimulating the development of new courses, and to a lesser extent, new degrees and requirements for doctoral students. Additionally, faculty members and department chairs perceive stronger departmental and institutional support for interdisciplinary research and education at IGERT institutions than non-IGERT institutions, though support for interdisciplinary education overall is modest compared with interdisciplinary research.

These reported institutional impacts vary across projects and may appear to be small within the scope of universities, but they are an indication that IGERT is catalyzing changes in graduate education via a funding mechanism that primarily supports graduate students. PIs are confident that they will be able to maintain some project benefits beyond the funding period, especially access to disciplines and expertise outside of students' home departments, and opportunities to study multiple disciplines. Many PIs and administrators report that other departments or programs at their home institutions have already adopted IGERT program elements.

Facilitating Diversity

IGERT projects have had a clear impact on the ability of participating programs to recruit, in the perception of faculty, more and better academically qualified individuals, and have the potential to increase the number of United States citizens currently enrolled in STEM doctoral programs. IGERT PIs and faculty members report successfully recruiting high quality students, including those students for whom the availability of an IGERT program was a factor in choosing to attend graduate school. IGERT projects provide an interdisciplinary alternative to what might otherwise be available to students, and IGERT students are more likely to pursue interdisciplinary education than their non-IGERT counterparts. The IGERT program has recruited minorities and women in science and engineering programs at rates equal to national averages. While IGERT projects have shown success in their recruitment efforts, the goal of the IGERT program is to be a leader in increasing diversity, and this challenge will continue to be a major focus of the program. The continued recruitment efforts of individual IGERT projects may in the future further increase the diversity of students enrolling in IGERT projects in these areas.

Conclusion

This evaluation finds that doctoral students participating in IGERT projects receive different educational experiences than non-IGERT students enrolled in single disciplinary degree programs, and that the IGERT program has been successful in achieving its goal of improving graduate educational programs in science and engineering. In various ways it has also begun to achieve its goal of catalyzing a cultural change in American graduate education, both by providing interested faculty members with an organized way to engage in interdisciplinary activity, and in developing alternate models of education that have been – and will likely continue to be – adopted by programs within IGERT host institutions. IGERT graduates enter the work force better prepared for the science of the future in the careers of the future.

