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Principles for Federal Support of Graduate and Postdoctoral Education

Introduction

Could one imagine federal agencies with different levels of support for graduate students and different policies, whose basis is often baffling, ever rationalizing their differences? Could one imagine federal agencies that support graduate students at generous stipend levels which increase with the cost of living? Could one imagine support of health insurance benefits and the true cost of education allowances as well? Could one imagine that federal agencies evaluate and track their portfolio of programs and students and regularly share their best or improving practices? Could one imagine easily developed collaborations among agencies to support newly identified interdisciplinary research directions? Alas, we have not yet arrived at this point, but significant first steps are well in progress in the form of the Principles for Federal Support of Graduate and Postdoctoral Education and Training in Science and Engineering now nearing final form.

In case your professional or avocational reading does not extend to Federal Register notices, let me remind you of a publication in the Federal Register on November 16, 2005 in which the Office of Science and Technology Policy (OSTP) invited public comment on proposed principles for federal agency programs that support graduate and postdoctoral education and training in science and engineering. In this article, I will provide a setting for the six principles, articulate the principles, reflect on several comments on the principles from CGS and from other organizations, describe changes in the principles that may be considered by OSTP, and finally speculate on some significant implications of these principles.[i]

The setting

The federal government supported approximately 70,000 graduate students and 30,000 postdoctoral scholars in science and engineering in 2003. About 54,000 (or 77%) of the graduate students and 24,000 (or 80%) of the postdoctoral scholars received their support as research assistants or associates on Federal grants and contracts. Most of the remaining 23% of the graduate students and 20% of the postdoctoral scholars received support through federal agencies' fellowships or traineeships.[ii] Consequently, the vast majority of federally supported graduate students and postdoctoral scholars are funded to contribute to the research goals of the grants and contracts on which they are supported. By any measure, the federal support for graduate and postdoctoral education is truly significant in both magnitude and scope.

The six principles

The principles articulated below are developed to help guide agencies in planning and designing, budgeting, and conducting extramural fellowship and traineeship programs (i.e., federal fellowship and traineeship programs for which the graduate students and postdoctoral scholars are receiving their education and training in non-federal institutions). Similarly, these principles should help guide, as appropriate, federal support of graduate students and postdoctoral scholars through other mechanisms, such as research assistantships supported by research grants or contracts, or through intramural programs. The principles articulated below are the ones published in the Federal Register. Changes may be made in response to a number of comments that are presently under final review by OSTP. Synoptic public responses from CGS, AAU and other organizations are provided after each principle with a brief commentary. One should remark that the principles collectively were widely embraced. As you will see, several themes emerge from considering the more specific critical comments.

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Principles for Federal Support of Graduate and Postdoctoral Education

- **Federal Support of Graduate and Postdoctoral Education and Training Is a Critical Investment in the Future.**

Federal government support for educating and training graduate and postdoctoral scientists and engineers is an essential investment in the future health, security, and quality of life of our nation's citizens. To ensure continued access to the human resources that lie at the foundation of a preeminent research and development enterprise, we must provide encouragement and opportunities for students with the aptitude and desire to pursue advanced degrees in science and engineering. Increasing the participation of underrepresented minorities, women, and persons with disabilities in graduate and postdoctoral education and training is a critical aspect in realizing the full potential of the nation's human resources. Federal government support is critical because: timeframes for realizing the benefits of the education and training are beyond the investment horizons of most corporations; the magnitude of the required support exceeds the collective capacity of foundations and other private sponsors; and the resulting reservoir of talent is a national resource upon which all public and private sector employers of scientists and engineers ultimately draw.

Selected public responses: Several comments suggested a need for guidance on specific levels of investment, e.g. increased funding for fellowships. These principles, however, are clearly intended to be overarching ones and are not suitable for providing guidance at that level of detail. Other comments concerned the education of US and foreign students, including the importance to the nation's economy of preparing US citizens for science and engineering jobs; CGS urged inclusion of a statement concerning research assistants and associates that "any limitations imposed by their citizenship status are determined by the host institution, which must comply with Federal laws and regulations."

Several more general comments encouraged a strong statement for support of reliable and consistent data collection on all federally supported research personnel and trainees, identified the need for clearly defined evaluation policies in order to provide data crucial to a program's future success, and encouraged the development of better models for predicting S&E workforce needs.

- **The Federal Investment Portfolio Must Broadly Support Science and Engineering Disciplines.**

The federal government-wide investment strategy should support graduate and postdoctoral education and training across a broad spectrum of science and engineering disciplines. It is increasingly the case that advances in knowledge and understanding arise from research in multiple disciplines. Similarly, follow-on development often requires teams of individuals from varying science and engineering fields. A workforce with strengths across disciplines therefore is imperative if experts from differing backgrounds are to be able to bring complementary perspectives to bear on complex problems. Another factor underlying the importance of the disciplinary breadth of the workforce is our inability to predict the areas that will contribute to any given advancement in the future. Even a problem initially raised in the context of a single discipline often is solved due to unanticipated contributions from other disciplines.

Selected public responses: Several comments contained suggestions related to

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Data Sources: International Student Trends

It is well known that India and China are the two largest sending countries of graduate students to the US. This is in part a natural result of the large size of the total population of each country, but the number of students enrolling in the US from each country has also been rising. Despite recent downturns, according to the Institute for International Education and their Open Doors reports, between 1995 and today, the number of graduate students from China increased 51% and those from India increased 125%. The ability to send students to study abroad at the graduate level is dependent on a sufficiently robust primary, secondary, and undergraduate system. Students earning bachelor's degrees must also have sufficient family or private savings to support their attempts to enter the admissions and visa processes. The government must also have policies in place to encourage students to travel abroad for their graduate degrees. China and India have each been able to accelerate development of their educational systems in order to prepare such large numbers of students to attend graduate school in the US. Each country has also seen overall economic development that allows large numbers of students to travel abroad for graduate school.

Not surprisingly, the large public investments made by each of these countries at the K-12 level over the last 20 years are increasingly being made at the university level. For example, in 1950, there were 27 full universities in India, in 2001 there were 272 (Guo 2005). As a result, the opportunity for Chinese and Indian students to study at home at the graduate level is growing. One implication of this for US graduate schools is the potential that fewer Chinese and Indian students will seek to study in the US. There are, of course, equally compelling reasons to believe that this potential will not become reality, particularly if China and India cannot develop the graduate capacity or quality to retain their own students, or if the acceleration of undergraduate education in each country leads to more students qualified for graduate study at home and abroad.

Table 1: Total Number of International Students Enrolled in US Institutions

Rank	1980	2005
1	Iran (47,550)	India (80,466)
2	Taiwan (19,460)	China (62,523)
3	Nigeria (17,350)	Korea (53,358)
4	Canada (14,320)	Japan (42,215)
5	Japan (13,500)	Canada (28, 140)

Source: IIE Open Doors

In speculating about any future scenario, it is important to note that China and India were not always such significant sending countries, particularly relative to other countries (See Table 1). If we look back twenty-five years, in 1980 the top five sending countries of international students (undergraduate and graduate combined) were Iran, Taiwan, Nigeria, Canada, and Japan (India was 9th, 9,250 total students in the US, and China 27th, 2,770 total students in the US). Today, Canada, Japan, and Taiwan still send large numbers of students to the US, but Iran (1,475) and Nigeria (6,140), for different and complex reasons, send many fewer students to the US and are no longer among the top 15 countries in terms of sending students to the US.

One question to ponder is, looking ahead, are there countries that may not now be sending relatively large numbers of students to the US but may in the future? By examining recent trends in international student flow and other demographic changes, we might be able to identify certain countries that are now showing the signs that China and India did in the recent past.

There are a variety of demographic trends we could look at to understand the emergence of China and India over the last decade. For instance, adult literacy in China has grown over the last 20 years. According to the World Bank, between 1985 and 2000, the adult literacy rate increased from 73% to 90%. Another excellent source of information on educational trends is *Asia's Educational Edge: Current Achievements in Japan, Korea, Taiwan, China, and India* (2005) by Yugui Guo. The book summarizes volumes of education-related statistics from a variety of governmental sources. According to Guo, Chinese student enrollment in higher education experienced notable growth in the 1980s and 1990s. For instance, higher education enrollment grew 22% in 1985 and 11% in1986. In the late 1980s and early 1990s, there was little change, but significant increases in higher education enrollment returned in the mid 1990s with a 16% increase in 1994, a 10% increase in 1995, and a 4% increase in 1996. By the early 2000s, higher education enrollment in China reached new heights, growing 35% in 2000, 30% in 2001, and 26% in 2002. Interestingly, in this latest period, higher education enrollment has accelerated while primary school enrollment in China has been decreasing.

In India, the growth in higher education enrollment has been equally notable and tracks with changes in adult literacy. The adult literacy rate in India has increased from 45% in 1985 to 57% in 2000. Between 1970 and 2000, higher education student enrollment grew from 2.5 million to 7.1 million. The participation of women in higher education is one of the factors driving this growth. In 1950, women made up 10% of higher education enrollment in India; by 1997 (the latest date available) that figure had grown to 40%. Similar to China, primary school enrollment in India has flattened, approximately unchanged, at 114 million, between 1999 and 2001.

There are numerous other demographic trends that would approximate each of these cited above. Examining these in greater detail would present an approach to better understanding developments in China and India. We can also use these trends to focus on other countries at similar developmental positions today. For instance, we might examine countries that have had recent upturns in sending international students to the US. While small in comparison to China and India, recent trends

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interdisciplinary training and suggested that the principle should specifically recognize the importance of interdisciplinary training as well as the importance of training in traditional disciplines. Two comments, including one from CGS, suggested expanding the principles to cover disciplines beyond science and engineering, including more broadly the disciplines of the arts and humanities.

- **Graduate Students and Postdoctoral Scholars Must Receive Quality Education and Training.**

Graduate students and postdoctoral scholars must receive an experience that combines both a high quality education and robust research training to secure the nation's future scientific and engineering enterprise. Attention to their intellectual growth during these critical years requires an environment that includes effective mentoring to promote their career development. Federal agencies should encourage the earliest possible completion of graduate and postdoctoral education and training, as well as efforts that foster the transition to the next step in the graduate student or postdoctoral scholar's career. As is the case for research programs, making award decisions through the use of merit review based on objective, expert advice promotes excellence in education and training through fellowship and traineeship programs.

Selected public responses: Several comments identified specific suggestions about what should be included in a quality training experience including supportive mentoring, laboratory project management training, career guidance, leadership skill training, and research ethics. Again these principles are broad policy statements and these suggestions, all good ones, are more appropriately addressed in the agencies' implementation of the principles.

Concerns were expressed about the need for a clear definition of quality, for data not presently available, and for methodologies for assessing quality. Apart from the principles as broad policy statements, the question of quality here depends on context; we in academia, not just the federal agencies, must play a primary role in defining quality.

Several comments, including one from CGS addressed issues of time to degree. CGS suggested the language, when "[c]onsistent with the best practices in various fields of study, federal agencies should encourage the earliest possible completion of graduate and postdoctoral education and training."

- **Federal Contributions Toward Graduate and Postdoctoral Education and Training are Provided in Partnership With Academic and Other Non-Federal Institutions.**

Graduate or postdoctoral education and training requires significant investment that includes financial support for the individual graduate student or postdoctoral scholar, and the investment needed for institutions to provide the education and training. Generally, a federal fellowship or traineeship program provides only a portion of this investment, with the balance provided by funds from other sources including, for example, the host institution, other federal programs, States, private sector organizations, and individual contributions. Consequently, the contribution toward this investment is made in partnership with academic and other institutions or parties. Federal agencies, therefore, should consider the impact on, and consult as appropriate, its partners when designing and conducting fellowship and traineeship programs. Federal agencies should have, and be able to articulate, a rational basis for the level of the federal program's contribution toward the education and training of fellows or trainees.

Selected public responses: Several comments focused on concerns that this principle would invite shifting more of the cost burden of graduate education and training from the federal government to universities. CGS commented that the "rational basis" language for the level of each program's contribution was too vague and urged additional consultation with the graduate education community.

- **Graduate Students and Postdoctoral Scholars Should Be Adequately Supported To Encourage Their Pursuit of Science and Engineering Careers.**

The level of support, including health and other benefits, provided to foster the education and training of graduate students and postdoctoral scholars is an important factor in attracting and retaining talented individuals to pursue careers in science and engineering. Levels of support provided by agencies should be reasonable and commensurate with the level of education and experience of the recipient. Agencies should consider annual adjustments in levels of support to address increases in the cost of living. Variances in support levels provided by federal agencies may, for example, depend on program purpose, program budget constraints, or demand for individuals in critical areas; however, such variations should have clear, rational bases.

Selected public responses: Several comments endorsed increased stipend and benefit support including health insurance coverage specifically. The details of such support are appropriately specified in the agencies' implementation of the broad principles. We note, however, that NIH has recently issued a policy for comment that would provide an identified health insurance benefit for its NRSA awards.

- **Federal Agencies Should Collaborate in Areas of Common Interest.**

It is important for federal agencies to coordinate their efforts to support education and training in science and engineering areas of common interest. Efforts among agencies should be synergistic and provide enhanced opportunities for graduate students and postdoctoral scholars. Agencies should collaborate to share data regarding these programs; to exchange information regarding effective practices; and to coordinate the design and conduct of programs, as appropriate.

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Selected public responses: Several comments strongly supported this principle with additional suggestions about better information sharing among federal agencies as well as a suggestion from CGS for a "broader framework for implementation that would allow regular input and consultation with non-Federal agencies."

Areas of continued concern

Viewed as a whole the public responses strongly endorse the six principles. Significant critical comments, however, centered on several issues most especially on the lack of availability of credible data on federally supported graduate students and postdoctoral scholars. These concerns have led an inter-Federal agency working group to create a draft proposal for a longitudinal survey of all those who receive federal support through fellowships, traineeships or research assistantships as graduate students or postdoctoral scholars. Tracking these individuals has been a goal of NSF and other federal agencies since at least 1995. We will have to see if this draft proposal moves forward. If the longitudinal survey does move forward, we will have data of enormous value for the agencies, for universities, and for policy makers.

A second group of critical comments was directed at the lack of specificity in several areas of the principles, for instance with regard to definitions of quality and effectiveness, or the adequacy of stipend and benefit support. These specifics are ones that a policy document cannot really address. A fair question, however, and one unanswered presently, is what plans for implementation of these principles are being developed by the agencies.

The six principles, the Principles for Federal Support of Graduate and Postdoctoral Education and Training in Science and Engineering as articulated above are thoughtful and robust. Their power will be evidenced by the actions of agencies in implementing them. We in the graduate community and CGS should be prepared to urge agency action under these principles as well as to provide expert consultation to the agencies. The principles are the first act in strengthening and enhancing federally supported graduate and postdoctoral education. We all look forward to the second act!

[i]These comments borrow freely from the language of the original Federal Register notice, as well as comments submitted to OSTP but also circulated publicly and received by the author.

[ii]The data are taken from the 2003 Survey of Graduate Students and Postdoctorates in Science and Engineering (National Science Foundation/Division of Science Resources Statistics). Research assistants or associates refer to graduate students or postdoctoral scholars funded through federal research grants or contracts. Graduate students or postdoctoral scholars supported on Traineeships are usually not selected by the federal agency, but the federal agency determines their level of support (although in some cases the level of support may be supplemented by other sources). Graduate students or postdoctoral scholars supported on Fellowships are selected by the federal agency, and the federal agency determines their level of support (although in some cases their level of support may be supplemented by other sources).

by Howard Jackson, CGS/NSF Dean in Residence

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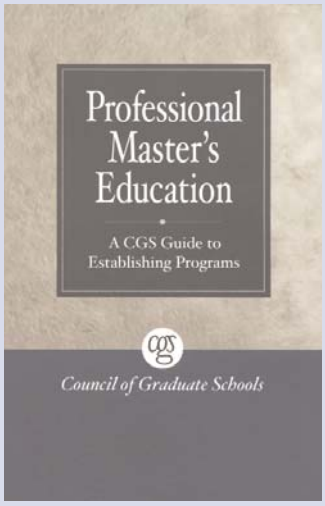

CGS ANNOUNCES NEW PUBLICATION ON PROFESSIONAL SCIENCE MASTER'S

One of the most exciting recent developments in master's education is the creation of professional master's degree programs. These programs provide graduate students with knowledge valued by employers in specific areas related to professional employment in business, industry, government, and nonprofit organizations. This guide to establishing programs, by Les Sims, draws on a vast range of experiences of recipients of CGS Professional Master's program feasibility and implementation grants to provide a comprehensive outline of best practices, activities, and processes required to create a professional master's program.

Copies of *Professional Master's Education: A CGS Guide to Establishing Programs* can be ordered online at CGS' website, www.cgsnet.org.

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Data Sources

might be suggestive of further growth in the future. Ghana, for instance, increased the number of graduate students it sent to the US 63% between 2001 (772 students) and 2004 (1258). Peru increased 34%, Kenya 32%, and Jamaica 23% over the same time frame. If we examine these countries in terms of adult literacy: Ghana increased its adult literacy from 51% in 1985 to 74% in 2000; Peru from 83% to 90%; Kenya 64% to 83%; and Jamaica from 80% to 88%. Similar statistics could be cited in regard to enrollment at the primary and secondary sectors. It remains to be seen whether these positive trends translate to substantially larger enrollments and the higher education level, the most immediate link to sending preparing students for graduate education.

Undoubtedly a full explanation of why China and India have been able to expand their economies and the number of international students sent would have to take account of many more political, social, and economic factors. No single variable or set of variables easily captures the complexity of factors that trigger national development. It is also obviously uncertain whether the recent growth in graduate students from Ghana, Kenya, Peru, and Jamaica will be sustained over time. Other countries, such as Mexico, Turkey, and Thailand, send substantial numbers of students and may in fact have greater resources to prepare and support students to come to the US to study. What is presented above is a simple and primarily conceptual approach to examining the landscape of international student flows with a more historic approach than is typically employed. Frequently, more concern is expressed about immediate trends and annual changes, than about historic patterns. To better understand future international student trends, it may be useful to take a more historic approach and employ more advanced analytical techniques. In doing so, stakeholders in graduate education might be better positioned to understand current patterns of student enrollment and anticipate future trends such as the emergence of new sending countries.

Further, more in-depth inquiry into international student flows might focus on the extent to which the return of US-trained graduate students supports a country's economic development. Concerns about 'brain drain' are likely a justification for why many developing countries are hesitant to encourage more of their own students to study in the US. However, if, as many have speculated but evidence has yet to show, more Chinese and Indian students trained in the US opt to return home after graduate school, confident that improved economic conditions will provide them with jobs in academia or research, perhaps 'brain drain' might be conceived of as a nonpermanent stage of development.

by Heath Brown, Director of Research and Policy Analysis

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Position Announcement
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The University of California, San Francisco (UCSF) is one of the leading biomedical research and health science education centers in the world. We are currently seeking an innovative and energetic academic leader, committed to service, growth and expansion, to serve as Associate Vice Chancellor (AVC) for Student Academic Affairs.

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The successful candidate must possess a doctorate in higher education or related field or a comparable combination of education and experience; three to five years of experience leading a large multi-service unit in an academic institution; excellent leadership, management and communication skills; and experience leveraging information technology services. Demonstrated experience overseeing and advancing administrative processes with an emphasis on providing quality customer-oriented services and knowledge of student services in a higher education environment is strongly preferred.

UCSF seeks candidates whose experience, teaching, research, or community service has prepared them to contribute to our commitment to diversity and excellence.

Please submit a cover letter and curriculum vitae or resume to Kimberly Newman, Coordinator, Office of the Executive Vice Chancellor and Provost, 513 Parnassus Avenue Box 0400, San Francisco, CA 94122 or by e-mail to KNewman@chanoff.ucsf.edu by June 30, 2006. Inquiries about this position should also be directed to Ms. Newman at 415-476-1660 or the email above.

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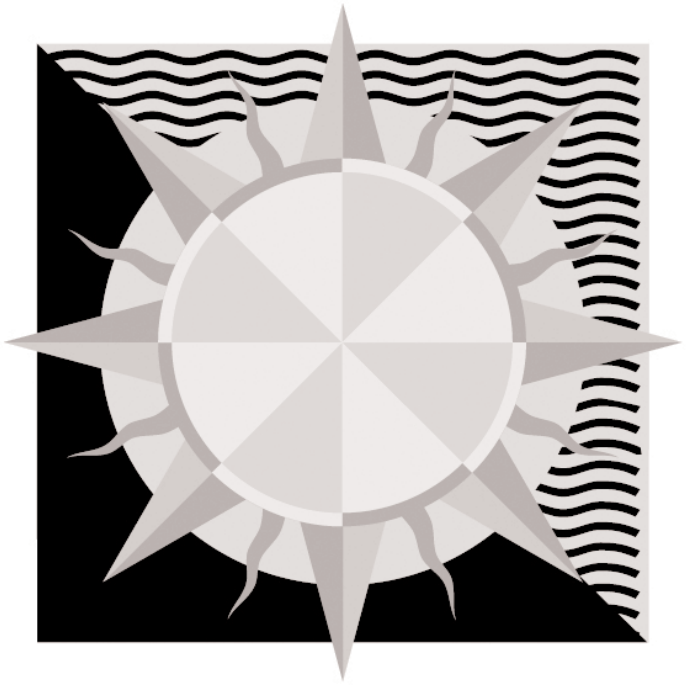

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