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CGS/NSF Workshop: “The Role and Status of the Master’s Degree in STEM” in Review

The Council of Graduate Schools (CGS) and the National Science Foundation (NSF) joined in hosting a day-long workshop, “The Role and Status of the Master’s Degree in STEM,” on May 18, 2010 at the National Science Foundation in Arlington, Virginia. The workshop, which represented one part of a two-fold project that was supported by NSF, brought together approximately 88 experts in graduate education, and representatives of funding institutions, federal agencies, and disciplinary societies to explore the role and status of master’s education in science, technology, engineering, and mathematics (STEM); some factors impacting completion and attrition at the master’s level; and career outcomes for individuals with master’s degrees in STEM.

The workshop opened with introductory remarks from CGS President, Debra W. Stewart, and the Acting Assistant Director of the Directorate for Education and Human Resources at NSF, Joan Ferrini-Mundy. In her remarks, Dr. Stewart framed the day’s dialogue by underscoring the need to “reset our collective thinking about master’s education,” and Dr. Ferrini-Mundy followed by calling attention to the need for “understanding the potential for innovating and improving graduate education at all levels.”

Tony Carnevale, Director of the Center on Education and the Workforce at Georgetown University, delivered the keynote address titled, “The Demand for STEM and Graduate Education through 2018,” which offered an encouraging prediction concerning the workforce needs of those with master’s degrees in STEM. According to Dr. Carnevale’s projections, there will be 7.9 million jobs in STEM in 2018, 24% of which will require a graduate degree. Moreover, master’s-level employment opportunities in STEM show a 17% growth and will increase quicker and greater than the overall economy (10%) with computer science and mathematics fields driving the growth. Master’s-level jobs in STEM are expected to be concentrated in manufacturing, professional, scientific, public administration, and other industries, with jobs in the life sciences more broadly dispersed across industries than any of the other STEM occupations.

The first of four panels offered a summative context with regard to master’s education in STEM, outlined burgeoning efforts to promote and sustain professionalization of master’s degrees, and delineated ranges of diversity inherent in STEM

master’s programs and among STEM master’s degree recipients. Eleanor Babco, Associate Program Director of CGS’ Professional Master’s Initiative, presented some of the types of master’s degrees in STEM; roles and functions of such degrees in academia and workforce at-large; and demographic data relative to STEM master’s degree recipients. She noted that master’s programs represent approximately 75% of total graduate enrollment in the US and women represent 60% of total enrollment in master’s programs. The greatest increase in STEM master’s degrees, for years 1998 to 2007, was in computer science and the least was in the physical sciences. Despite overall growth in STEM master’s enrollments, underrepresented minority groups, which included over 30% of 18-24 year olds in 2007, earned only 18% of all master’s degrees, 16% of master’s degrees in STEM, and 12% of natural science and engineering degrees.

In a similar vein, Sheila Edwards Lange, Vice President for Minority Affairs and Vice Provost for Diversity at the University of Washington, explored the role of the master’s degree on pathways to and through doctoral education. Dr. Edwards Lange’s research demonstrated findings that build a framework for understanding proliferations in the attainment of master’s degrees in STEM, pose critical questions about the role and impacts of master’s education in the doctoral education recruitment and training pipeline, and may have appreciable implications for better understanding key factors and intervention points in the STEM educational pipeline. Some salient findings of Dr. Edward Lange’s research point to the fact that students from underrepresented minority groups are more likely to experience a transition between master’s and doctoral degrees and are more inclined to earn the bachelor’s, master’s, and doctoral degrees at three different institutions in comparison to their majority counterparts. Subsequently, Vice Provost and Dean of the Graduate

continued on next page

INSIDE

Data Sources	4
SED Summary Report Gets a Makeover	6
New Members	7

CGS/NSF Workshop

School of Marquette University, William Wiener, rounded out the first panel with a report of trends in master's education in STEM at Marquette University and underscored the integral role that master's education plays in the preparation of well-trained professionals for the business and industry workforce; as well as its role as the "backbone of the American educational enterprise."

The second workshop panel addressed the issue of completion and attrition in master's education in STEM, broadly, from three institutional perspectives. Moheb Ghali, Vice Provost for Research and Graduate Dean at Western Washington University, considered the feasibility of increasing the accuracy of data collection methods that are used in gathering attrition, completion, and time-to-degree data. He shared his use of the Banner Student Information System to examine the completion rates and average time-to-degree for 4 cohorts across 24 master's programs. Dr. Ghali noted that the same process may be applied to gain greater understanding of individual attrition, completion, and time-to-degree rates and submitted a written methodology to workshop participants for replication with their institutional data.

Brenda Brouwer, Associate Vice-Principal and Dean of the Graduate School at Queen's University in Ontario, shared master's and doctoral enrollment and completion data that exemplified trends in graduate education in a Canadian context. Queen's University currently offers 27 master's programs in STEM, with approximately 50% of the graduate student population pursuing studies in a STEM field. Of the graduate students pursuing studies in STEM, 47% are master's-level. Dr. Brouwer's presentation accentuated the role of the master's degree at Queen's University and in Canada in general as a prerequisite for most doctoral programs.

Purdue University's Dean of the Graduate School, Dr. Mark J.T. Smith, advanced the discussion of attrition and completion through analyses of 10-year completion data that showed completion trends for graduate students with bachelor's and master's degrees upon admission to doctoral programs across five broad fields. Dr. Smith stated that regardless of gender or discipline, completion rates were higher for those who had earned master's degrees prior to admission to the doctoral program than for those who entered the doctoral program immediately after earning the bachelor's degree. Some factors that were cited as being influential and, thus, impact the completion process are major professors/mentors; preparation for and engagement in the research process; personal/family-related stressors; financial stressors; and departmental or broader academic climate, to name a few.

The third and fourth panels updated workshop participants on the NSF Science Master's Program (SMP), CGS Professional Science Master's (PSM) Initiative, and career outcomes for master's degree recipients in STEM, respectively. In 2010, NSF Science Master's Program considered 214 full proposals and granted 21 awards to programs throughout the United States including Puerto Rico. Myles Boylan, Program Director of the

Division of Undergraduate Education and Division of Graduate Education at NSF, discussed numerous benefits of the Science Master's Program to industry leaders and members of the educational community. The Science Master's Program increases opportunities for employers to actively engage in the development of graduate education and training that meet the targeted needs of the workforce. In similar fashion, CGS' PSM Initiative continues to demonstrate the demand for professionals who possess a master's-level education in STEM coupled with professional skills components that are developed in consultation with employers. Since its inception in 1997, the PSM Initiative has seen a dramatic increase from less than 10 programs in the first year to a growth of over 36 programs in 2009-10. There are currently a total of almost 200 PSM programs at approximately 94 institutions at various levels of the Carnegie Classification System, but they are particularly concentrated at Master's Colleges and Universities (larger programs), Research Universities (very high research activity), and Research Universities (high research activity). Carol Lynch, Senior Scholar in Residence and Program Director of the CGS Professional Master's Initiative, discussed ongoing efforts to encourage states to endorse PSMs, promote PSM sustainability, and ensure that PSMs become regular features of graduate education in STEM.

In his presentation regarding career outcomes for STEM master's degree recipients, B. Lindsay Lowell, Director of Policy Studies at Georgetown University's Institute for the Study of International Migration, stated that the *Science and Engineering Indicators 2010 Report* points to increases in the availability of qualified individuals who may contribute to the STEM workforce. Although the career outlook for STEM master's degree recipients is positive in the main, there is a need for continual cultivation of talent at all levels of the STEM educational pipeline to ensure the availability of human capital and competitiveness at national levels. Wayne Stevenson, Director of Science Education Programs at Oak Ridge Associated Universities, described efforts to identify and shape the early career goals of STEM trainees. Workshop participants were informed of the partnerships that Oak Ridge Associated Universities foster to advance research and education in STEM through fellowships, scholarships, K-12 teacher development, and other training opportunities. Lilian Wu, Program Executive at IBM Global University Programs, laid bare the complexities and interconnections of building and sustaining a strong and efficient workforce and emphasized the need for individuals who come to the workforce with core strengths of a given discipline but who are also dynamic, adaptable, creative, and able to reach across disciplines to shape and innovate in ever-changing world contexts.

With the support of funding from the Alfred P. Sloan Foundation, CGS developed and disseminated a white paper titled, "Completion and Attrition in Master's Programs in STEM," in advance of the workshop, as an empirical context for the workshop dialogue and as a concerted effort to address the

paucity of master's completion and attrition research. The CGS white paper offers a broad view of the functionality of the master's degree; highlights the growth of master's degrees in the United States in STEM fields; explores some of the categories and characteristics of master's degree programs in STEM; and examines completion and attrition in relation to master's programs in STEM. Additionally, it summarizes the second component of the NSF project which includes research on the relationship of master's degree completion to doctoral degree completion.

The research that forms the basis of the white paper shows increases in the numbers of master's degrees awarded in STEM and noteworthy gains for women and US minorities. It is becoming increasingly more evident that master's education is paving the way for greater employment opportunities and income advantages in STEM fields that benefit from a well-trained workforce with master's-level training. There is further evidence to suggest that institutions of higher education are heeding the calls for dynamic master's-level educational programs through the provision of a variety of forms and models of degree programs. CGS reviewed 378 STEM master's programs at 30 master's-focused and research universities and observed four broad master's program models: master's degrees awarded en route to the PhD, stand-alone degrees, dual degrees, and accelerated bachelor's/master's degrees. The review of master's programs confirmed a great deal of variation within and among program models, in general, and offered some operational definitions of program variations that exist in the United States.

Although completion and attrition have been explored at the doctoral level since the 1950's, these issues have been addressed to a lesser extent for master's education.

The white paper addresses the dearth of available master's completion and attrition research and data by citing the availability of only two cross-university and cross-discipline comparative studies, both of which were completed outside the US. CGS examined master's completion data supplied by five universities in the US with the awareness that the five data sets would not be directly comparable due to the use of different methodologies for collecting the data and computing completion rates used by the institutions. However, some useful findings were gleaned from these data. The five universities included four public research universities and one master's-focused institution.

In general, these data show higher rates of completion for women than for men in STEM, specifically in the field of engineering. Across the five universities, there was considerable variance in the completion of master's programs. Therefore, the authors of the white paper point to the need for future studies that offer direct comparisons within STEM fields and support comparative analyses across disciplines.

As it concerns the impact of master's degree attainment on doctoral degree completion, CGS examined data from four of the institutions that participated in the PhD Completion Project, all of which are research universities with very high research activity. Each of these institutions provided 10-year PhD completion data for seven classes of students who were admitted to doctoral programs from 1992-93 through 1998-99

and seven-year completion data for students who were admitted to programs from 1999-2000 through 2001-02. Data were provided for six broad fields which included engineering, life sciences, mathematics, physical sciences, social sciences, and humanities. The students were classified according to their status with respect to the master's degree upon admission to the PhD: direct admission into a doctoral program from the bachelor's degree; admission into a doctoral program after having completed a master's degree at the same institution; and admission into a doctoral program after completion of a master's degree at a different institution. In sum, for both the seven- and ten-year cohorts, students who earned a master's degree from a different institution prior to their admission to a doctoral program demonstrated higher rates of doctoral degree completion than their counterparts who entered a doctoral program after earning a master's degree at the same institution or students who entered a doctoral program directly after earning the bachelor's degree. This finding remained true regardless of gender and citizenship.

Moreover, the white paper summarizes an initial effort to systematically identify factors that impact completion and attrition at the master's level via a Dean Dialogue and an invitation-only focus group which were convened in 2009 to solicit feedback from participating deans. Eighty-two deans contributed to the Dean Dialogue and 14 deans participated in the invitation-only focus group. The dialogue and focus group contributors discussed the impact of factors such as financial support; personal, family, and job-related issues; faculty mentoring and teaching; students' motivation and understanding of commitment and opportunities; program rules, policies, and procedures; and others on completion and attrition in master's education.

To promote more individual exchanges and cross-fertilization of ideas regarding the content of the white paper and workshop presentations, participants were encouraged to engage in two small group discussions at the CGS/NSF workshop that offered participants opportunities to provide feedback regarding the ways in which presented data comport with the direction of the STEM master's degree at their institutions and ways that the attrition and completion data may support improvement of student outcomes. The workshop was considered to be an enormous success as the first national conversation focused on the broad topic of master's education and its important role in today's workplace. The quality of the conversation was excellent, producing ideas that will be valuable in determining next steps for moving the conversation forward. The outcomes of the workshop and small group discussion responses will be summarized in a final draft of a white paper that will be produced by the Council of Graduate Schools. The workshop presentations are currently available on the CGS website.

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Data Sources: Employment Trends among New Doctorate Recipients

In academic year 2009-10, over 60,000 individuals earned doctoral degrees. This spring, degrees in hand, most of these individuals began the search for a job ... in the worst labor market in the United States in at least a generation (Economic Policy Institute, 2010). The National Bureau of Economic Research (NBER) has not definitively declared the recession ended, but data from the Bureau of Labor Statistics (BLS) indicate some recovery of jobs in 2010 after nearly two years of steady losses (Bureau of Labor Statistics, 2010b). Definitive data will not be available for some time on employment outcomes for this year's doctorate recipients, but historical data from the Survey of Earned Doctorates (SED) provide some insight about how new doctorate recipients may have fared in the recession.

The latest SED data are for doctorate recipients in 2007-08 (National Science Foundation, 2009). Most of these doctorate recipients entered the job market within a few months of the start of the recession, which began in December 2007. The full impact of the recession had yet to be realized by mid-2008, but the job market had already shed more than 650,000 jobs in the first six months of 2008 alone, just as most of these new doctorate recipients were looking for employment (Bureau of Labor Statistics, 2010b).

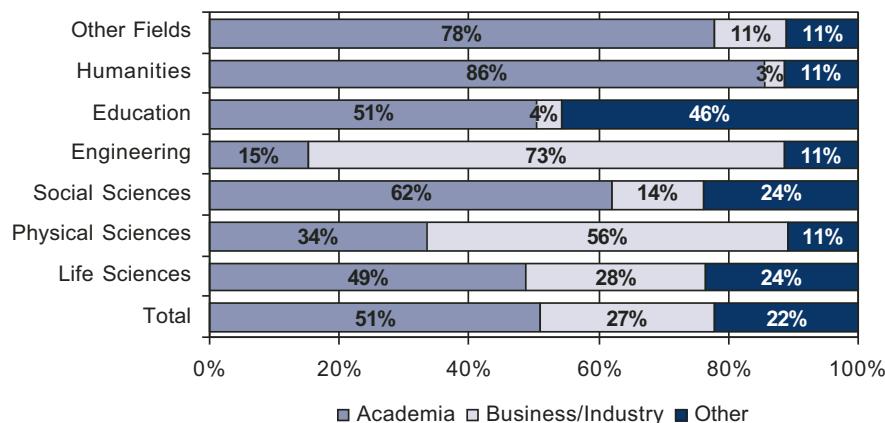
Despite the gloomy job market, more than two-thirds (69%) of doctorate recipients in 2007-08 reported definite commitments for employment or postdoctoral study at the time they completed the SED. Doctorate recipients in humanities (64%) and engineering (65%) were least likely to report definite commitments, while those in education (73%) and 'other fields' (76%) were most likely to report definite commitments for employment or postdoctoral study.

Men were slightly more likely than women to report definite commitments for employment or postdoctoral study—70% vs. 68%. US citizens and permanent residents were more likely than temporary visa holders to report definite commitments for employment or postdoctoral study—70% vs. 66%. And American Indian (74%) and white doctorate recipients (72%) were more likely to have definite commitments than Hispanic (66%), Black (64%), and Asian (62%) doctorate recipients.

Among doctorate recipients with definite commitments, 64% had offers of employment and 36% planned to pursue postdoctoral study. By broad field, doctorate recipients in education (95%), 'other fields' (93%), and humanities (86%) were most likely to have commitments for employment, while those in life sciences (66%), physical sciences (53%), and social sciences (33%) were most likely to have commitments for postdoctoral study.

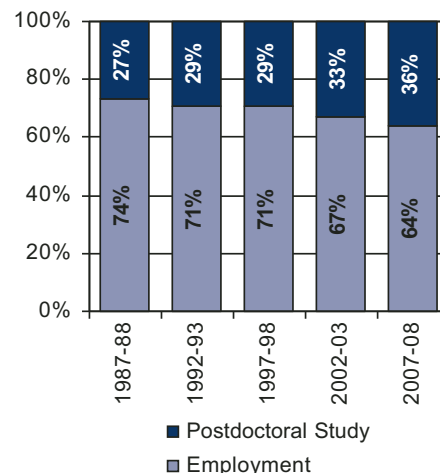
Among doctorate recipients with definite postgraduation employment commitments in the United States (excluding individuals with commitments for postdoctoral study), about half (51%) had commitments from academia, about one-quarter (27%) had commitments from business/industry, 6% from government, 5% from non-profit organizations, and 11% from employers in other/unknown sectors. Humanities doctorate recipients and those in 'other fields' were most likely to have commitments to work in academia, while those in engineering and physical sciences were most likely to have employment commitments in business/industry (see Figure 1). In Figure 1, 'other' includes government, non-profit, and other/unknown sectors. Education doctorates recipients were most likely to have commitments to work in 'other' fields, which includes elementary and secondary schools.

Figure 1. Employment Sector of Doctorate Recipients with Definite Postgraduation Employment Commitments in the US by Broad Field of Study and Sector, 2007-08



Note: Other includes government, non-profit, and other/unknown.
Source: National Science Foundation, 2009

Figure 2. Postgraduation Plans of Doctorate Recipients with Definite Commitments, 1987-88 to 2007-08



Source: National Science Foundation, 2009

Doctorate recipients in 2007-08 were only slightly less likely to have definite commitments for employment or postdoctoral study than their counterparts who graduated five and ten years earlier. Sixty-nine percent of doctorate recipients in 2007-08 had definite commitments, compared with 71% in 2002-03 and 70% in 1997-98. The share of new doctorate recipients with employment commitments in academia dropped slightly between 2002-03 and 2007-08, from 54% to 51%, while the share with employment commitments in business/industry rose from 21% to 27% in the same time period.

Over the past two decades, there has been a gradual decline in the share of doctorate recipients with definite commitments for employment, falling from 74% in 1987-88 to 64% in 2007-08 (see Figure 2). Conversely, the share of doctorate recipients with definite commitments for postdoctoral study rose from just over one-quarter in 1987-88 to more than one-third in 2007-08.

While the data on employment trends from the SED provide an interesting historical perspective, doctorate recipients in 2008-09 and 2009-10 undoubtedly faced a tougher job market, as more jobs were shed in 2008 and 2009 as the recession deepened. Over the past two years, the higher education press has reported numerous cases of hiring freezes at US universities, as well as a dismal employment outlook in some disciplines, particularly the humanities, suggesting that new doctorate recipients are likely finding it more difficult to find jobs today than their counterparts who graduated prior to the recession. One data point, however, suggests that not all the news is bleak.

National unemployment data for 2009 indicate that despite the recession, the average unemployment rate for doctoral degree holders remained low, at 2.5% (Bureau of Labor Statistics, 2010a). While higher than the 2.0% average unemployment rate for individuals with PhDs in 2008,

doctoral degree holders remain much less likely to be unemployed than individuals with lower levels of educational attainment. As shown in Figure 3, doctoral degree and first-professional degree holders have levels of unemployment that are about one-fourth that of high school graduates and about one-sixth that of individuals with less than a high school diploma.

What cannot be parsed from the BLS data is what population was most affected by the increase in unemployment among doctoral degree holders in 2009. It is possible that the increase from 2.0% in 2008 to 2.5% in 2009 was due in part to new doctorate recipients, but it is more likely that it is a combination of unemployment among new and experienced workers. Data from the *2009 Survey of Earned Doctorates*, to be released in late 2010, will provide more definitive data on the true impact of the recession on doctorate recipients in 2008-09.

By Nathan E. Bell, Director, Research and Policy Analysis

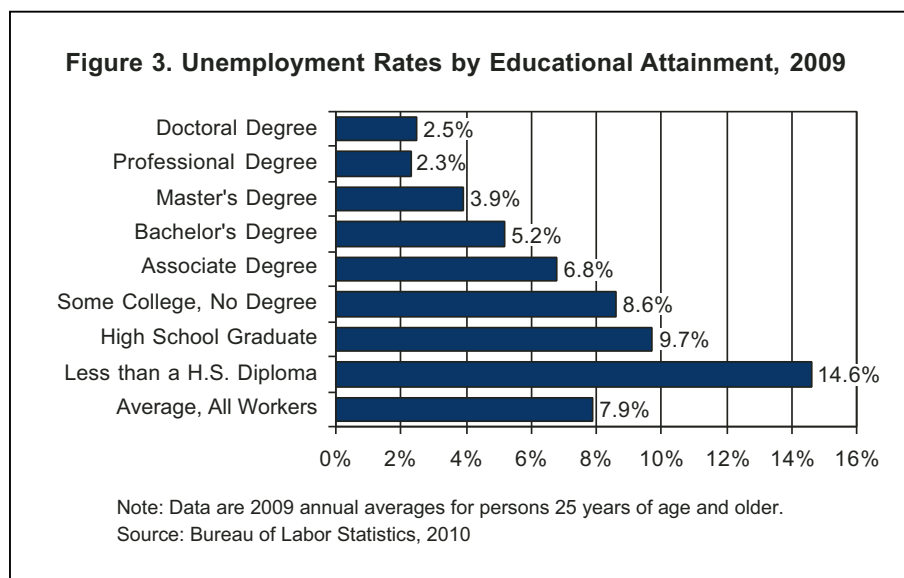
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SED Summary Report Gets a Makeover

The Survey of Earned Doctorates (SED), conducted by the National Science Foundation, is an annual census of individuals who receive research doctorates from US institutions. Institutional researchers, labor-force planners, academic researchers, and others use the data collected by the SED as a resource for understanding the characteristics and trends in doctoral education and doctorate degree holders. Although SED data are reported in several publications, the annual *Summary Report* is the most comprehensive and widely cited. The format and organization of this publication have changed little over the past 20 years, but that's about to change.

Why depart from a well-established format? Comments from reviewers and others have made it clear that the report's presentation needed rethinking, and we listened. According to readers, much of the old report's lengthy narrative section (20 single-spaced pages) was devoted to largely redundant descriptions of the data presented in figures and tables. Its organization, which mirrored that of the SED survey instrument, provided little context for comprehending interconnections among the data. The rationale for the ordering of the 50+ statistical tables wasn't clear, and readers were forced to skip back and forth through several tables to find related data items. In short, the traditional format and organization of the *Summary Report* did little to help readers draw meaning from the data.

The new *Summary Report* will be patterned after the *Key Science and Engineering Indicators: 2010 Digest (SEI Digest)*, a short, visually appealing publication that highlights important trends and data points that appear in the comprehensive *Science and Engineering Indicators 2010* volume. (See the *SEI Digest* here: <http://www.nsf.gov/statistics/digest10/nsb1002.pdf>.) Like the *SEI Digest*, the new *Summary Report* will be brief but informative. It will be organized into a small number of themes that raise important questions about doctorate recipients. Each theme will encompass four to six short narratives—key observations—that address the focal question of the theme, and each observation will be supported by a color figure that displays SED data. Two samples of organizing themes and selected key observations that may appear in the new *Summary Report* follow:

Who are they?

- By the numbers, particularly new doctorate holders in science and engineering fields
- Temporary visa holders
- Women, in all fields of study

Postgraduation: What do they do? And where?

- Definite commitments for employment or postdoctoral appointments

- Positions in industry
- Temporary visa holders staying in the United States

The new *Summary Report* will encompass online resources in addition to the printed publication. Online, the interactive features will enable readers to explore the data that support each key observation. Moving the cursor over the graphic elements of a figure will show the underlying data values, and, with a single mouse-click, the reader can view the entire data table for the figure. To accommodate readers' needs for further analysis and presentation of these data, all of the figures will be available for download in PowerPoint, image (JPEG), and Excel formats. (See the online version of the *SEI Digest* for a demonstration of these interactive features: <http://www.nsf.gov/statistics/digest10/>.)

The format of the new *Summary Report* is intended to draw attention to important trends in doctoral education in a compact, portable volume that readers can then explore in greater depth by studying the report's statistical tables. The 50+ tables presented in past editions of the report will no longer appear in the bound volume but will be available online both in portable document format (PDF) and as Excel files for easy viewing, printing, and downloading. Several of these tables are being revised to improve their readability, and the entire suite of tables will be reordered so that tables displaying related data are grouped together.

We believe these changes will make the new *Summary Report* much more useful to readers. The less-text, more-figures design will make it easier for readers to interpret SED data quickly. The theme-based organization of the report will highlight and provide context for important data trends, which will help readers form connections among diverse data and gain new insights about emerging issues in doctoral education. The online resources of the *Summary Report* will encourage readers to interact with the data online and the download feature will make figures and tables available to readers and researchers for their own uses.

Please stop by the SED booth at the Council of Graduate Schools Annual Meeting this December in Washington, DC. We will be handing out flash drives containing the new *Summary Report*, including the full array of statistical tables in PDF and Excel formats. The online version of the *Summary Report* will be published in advance of the CGS meeting, and the print version should arrive in your mailbox soon afterward.

We look forward to hearing your reactions to the new *Summary Report*.

By Mark Fiegner, Project Officer, Sciences Resources Statistics Division, National Science Foundation

Welcome New International Member: University of Iceland

Welcome New Corresponding Associate Member: The New York Times

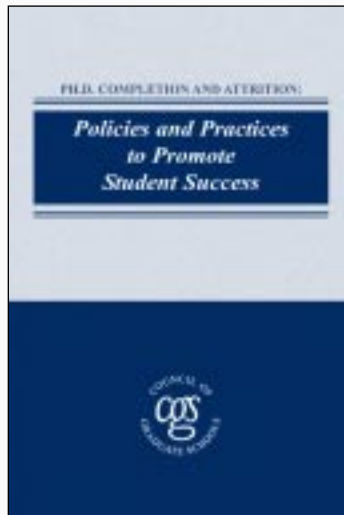
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Editor: Heidi Shank, Director, Meetings and Member Services

A New Publication from the Council of Graduate Schools



PHD COMPLETION AND ATTRITION: POLICIES AND PRACTICES TO PROMOTE STUDENT SUCCESS (2010)

This is the fourth in a series of monographs from the CGS PhD Completion Project. This monograph reports on policies and practices at participating institutions that aim to improve PhD completion rates and reduce attrition in doctoral programs. These policies and practices are categorized into six broad institutional and programmatic categories: selection and admissions; mentoring and advising; financial support; research mode of the field; curricular and administrative processes and procedures; and program environment.

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