

Metrics for Assessing Broadening Participation in a Title IX Context

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Abstract

Despite policies encouraging participation by women in science, technology, engineering, and mathematics (STEM), fewer women than men enter and remain in many of these fields, and those who do persist are less likely to reach the upper levels of academe than men. Title IX legislation mandates equal opportunity for women and men in all educational activities as well as in federally funded programs, including funded research programs. Although women have increased their numbers and visibility in many fields since Title IX became law in 1972, they remain a minority in most STEM fields and face barriers and discrimination at all stages of their education and careers. Government agencies have several tools to use as they promote gender equity through enforcement of Title IX, and these tactics have removed some covert barriers to participation, but women in STEM higher education and research continue to face overt obstacles and negative attitudes from their colleagues. For individuals in the STEM fields, the National Science Foundation (NSF) promotes participation of underrepresented groups (e.g., women, minorities, and persons with disabilities) in its funded activities through the broadening participation aspect of its Broader Impacts merit review criterion. All potential grantees must explain in their proposals how the project will affect society, including how well it would encourage individuals from underrepresented groups. The Center for the Advancement of Scholarship on Engineering Education (CASEE) of the National Academy of Engineering convened a workshop to discuss possible metrics by which grantee efforts at broadening participation might be demonstrated. Metrics appropriate for use by grantee institutions as well as metrics appropriate for use by individual investigators were identified. The institutional metrics center on leveraging information that institutions already collect, but generally do not publish (i.e., affirmative action and utilization plans). Individual metrics center on comparisons over time of the compositions of various populations in various activities (e.g., the number of women identified by, recruited to, retained within, and completing a summer research workshop program). This presentation will summarize the process used to identify the metrics and discuss their possible use within a Title IX context.

Introduction

Policies exist that prohibit sex discrimination in educational endeavors in public institutions, but despite these policies women remain underrepresented in science and engineering fields.

Although the gender balance has improved over the past half century, women remain an overwhelming minority in STEM fields. For example, between 1960 and 1990 women's representation in science and engineering more than doubled, increasing from 16.0% of the science and engineering bachelor's degrees awarded in 1960 to 40.2% of the degrees awarded in 1989. The percentage of women receiving doctoral degrees in these fields also increased from 6.35% to 27.7% over the same time period. On the other hand, women were also better represented across all disciplines, receiving 38.2% of bachelor's and 10.4% of doctoral degrees in 1960 and 52.7% of bachelor's and 36.6% of doctoral degrees in 1989 (Barber 1995). However, the patterns of change in the gender proportions of bachelor's degrees were not all due to more women receiving these degrees. Specifically, science and engineering degrees for women comprised 13.7% of all bachelor's degrees awarded to women in 1960 and 22.7% of all women's degrees in 1990. Among men, the same percentages dropped from 44.4% in 1960 to 38.9% in 1976. These gender-specific changes did not continue after 1976. Thus, although women increased their share of science and engineering bachelor's degrees between 1960 and 1990, part of that change was due to a decrease in men receiving those same degrees (Barber 1995).

Despite these changes at the bachelor's level, there were no significant changes in the percentages of college graduates who continued on to the doctoral level, although both women and men began to earn more STEM doctoral degrees in the 1990s. This increase followed a steep decline in the number of men earning doctoral degrees in science and engineering between 1970 and 1990. Overall, between 1960 and 1990 women did not make gains compared to men in science and engineering doctoral degrees as a percent of all doctoral degrees. However, the percentage of women in the science and engineering workforce across that period of time did increase, although women were generally paid less than comparably-experienced men (Barber 1995).

Some progress has occurred in the last decade. Women received 54.8% of all the bachelor's degrees in 1995 and 57.6% of all degrees in 2004. Women also increased their share of STEM bachelor's degrees, earning 46.5% of degrees in 1995 and 50.4% in 2004. As shown in Figure 1, women earned more degrees and men earned fewer degrees between 1995 and 2001, but since 2002 both men and women earn more STEM bachelor's degrees every year. Overall, women increased their STEM degree numbers each year, earning 175,931 bachelor's degrees in 1995 and 229,412 degrees in 2004, while men's degrees declined from 202,217 in 1995 to a low of 197,623 in 2001 before returning to 225,566 in 2004 (National Science Foundation 2007).

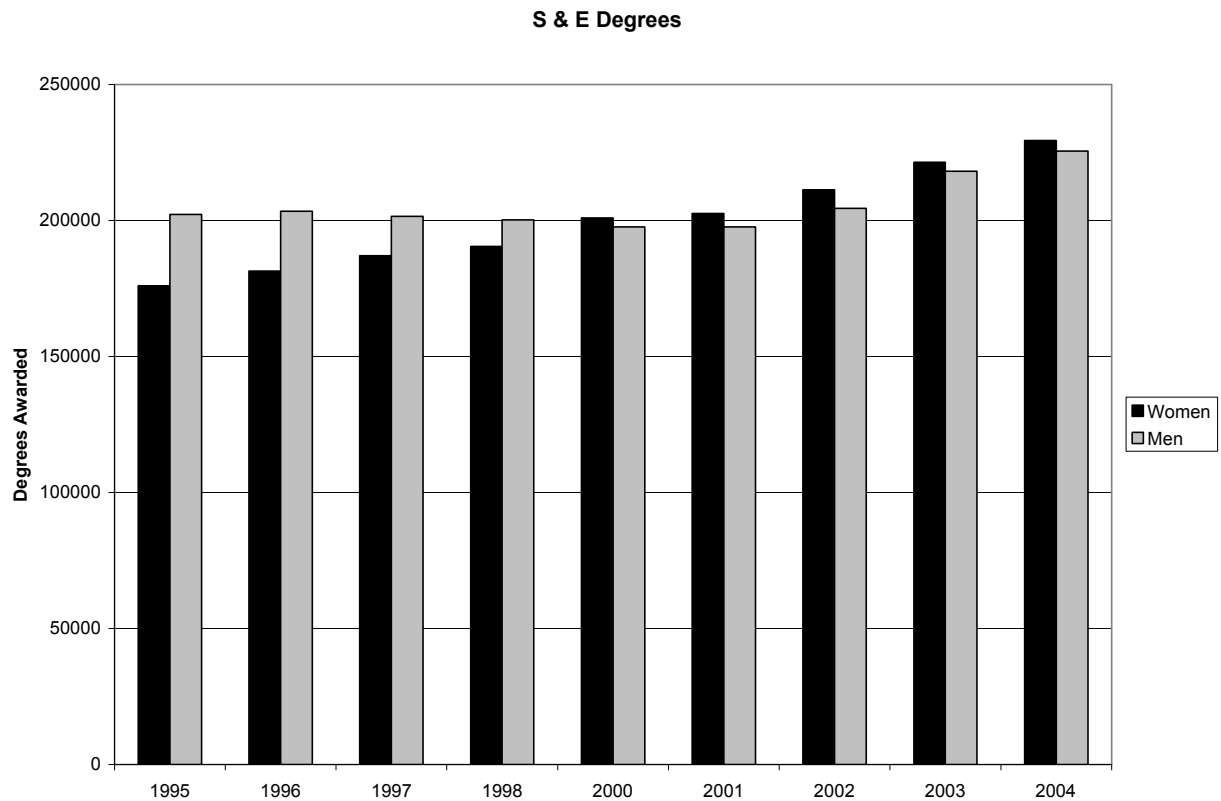


Figure 1. STEM degrees by gender, 1995—2004

However, women remain underrepresented in engineering, earning 20.5% of these degrees in 2004, up from 17.3% in 1995. As shown in Figure 2, the pattern of men's engineering bachelor's degrees mirrors that of STEM degrees overall, with a decline in the latter half of the 1990s and rebounding in the first half of this decade. Men earned 52,421 engineering bachelor's degrees in 1995, only 47,320 degrees in 2000, and 51,418 engineering degrees in 2004. However, unlike overall STEM degrees, women do not substantially increase their engineering degrees, with 10,950 engineering degrees awarded to women in 1995 and 13,257 awarded in 2004 (National Science Foundation 2007).

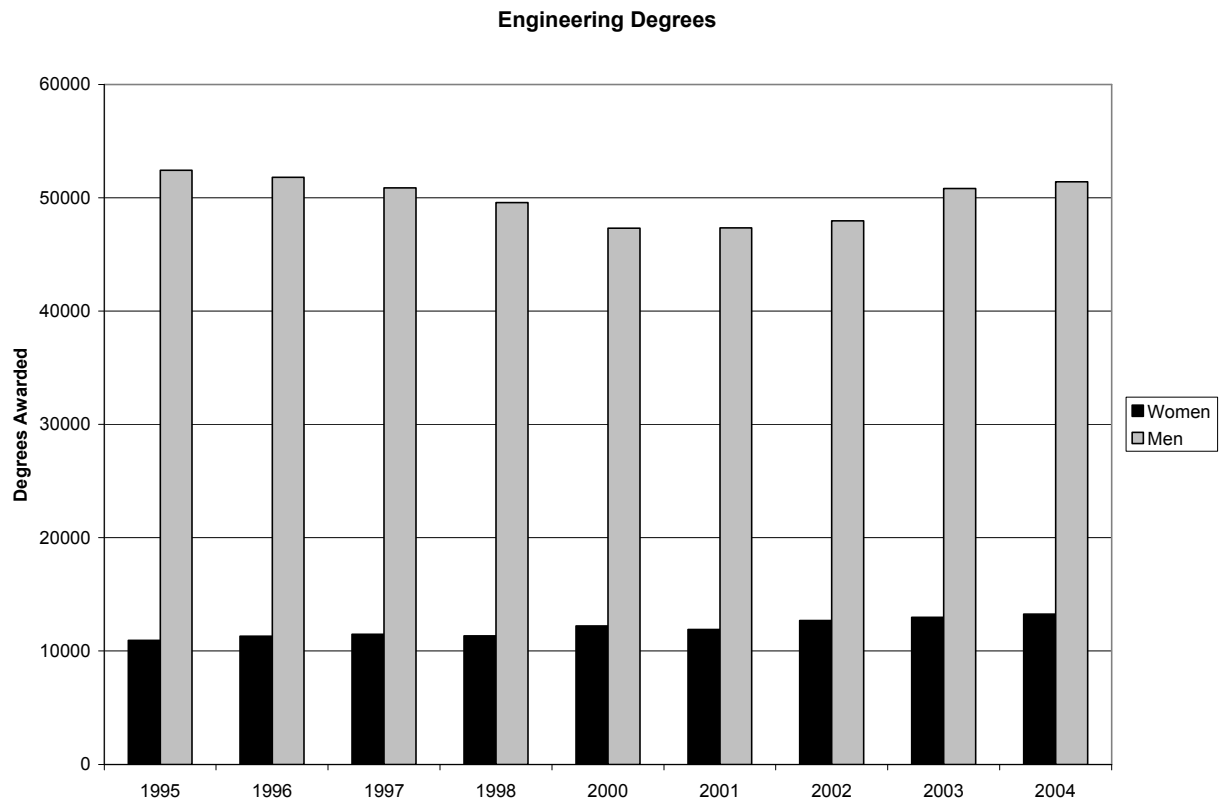


Figure 2. Engineering degrees by gender, 1995-2004

Women also do not continue their education in the STEM fields at the same rate as they receive their undergraduate degrees, although they have made some progress towards equity in the last decade. In 1995, women earned 39.5% of all doctoral degrees, while in 2004 they earned 45.4% of doctorates. However, this increase in women's share of doctorates arose from both more women and fewer men receiving doctorates (National Science Foundation 2007). While men earned 25,161 doctorates to women's 16,418 in 1995, in 2004 women earned 19,098 while men earned 22,976. In STEM, however, the percentage of women doctorate holders remained low, increasing from 8,287 (31.4%) in 1995 to 9,819 (37.4%) in 2004. Men did not earn as many STEM doctorates in 2004 (16,405) as they did in 1995 (18,117). Not surprisingly, the numbers for engineering doctorates are lower, with women increasing from (696) 11.7% of all engineering doctorates in 1995 to (1,014) 17.6% in 2004, while men decreased from 5,270 engineering doctorates in 1995 to 4,750 in 2004 (National Science Foundation 2007). Figure 3 indicates the numbers of women and men earning doctorates in STEM as well as in engineering between 1995 and 2004. Women also have yet to achieve equity among tenured faculty members, although the percentage of women in STEM academic jobs rose from 9% in 1973 to 30% in 2003 (National Science Foundation 2006). However, women tend to remain in junior level positions longer than men and are also more likely to work in nontenure-track jobs, and marriage and child-rearing affect their careers differently than those activities affect men's careers (National Science Foundation 2004).

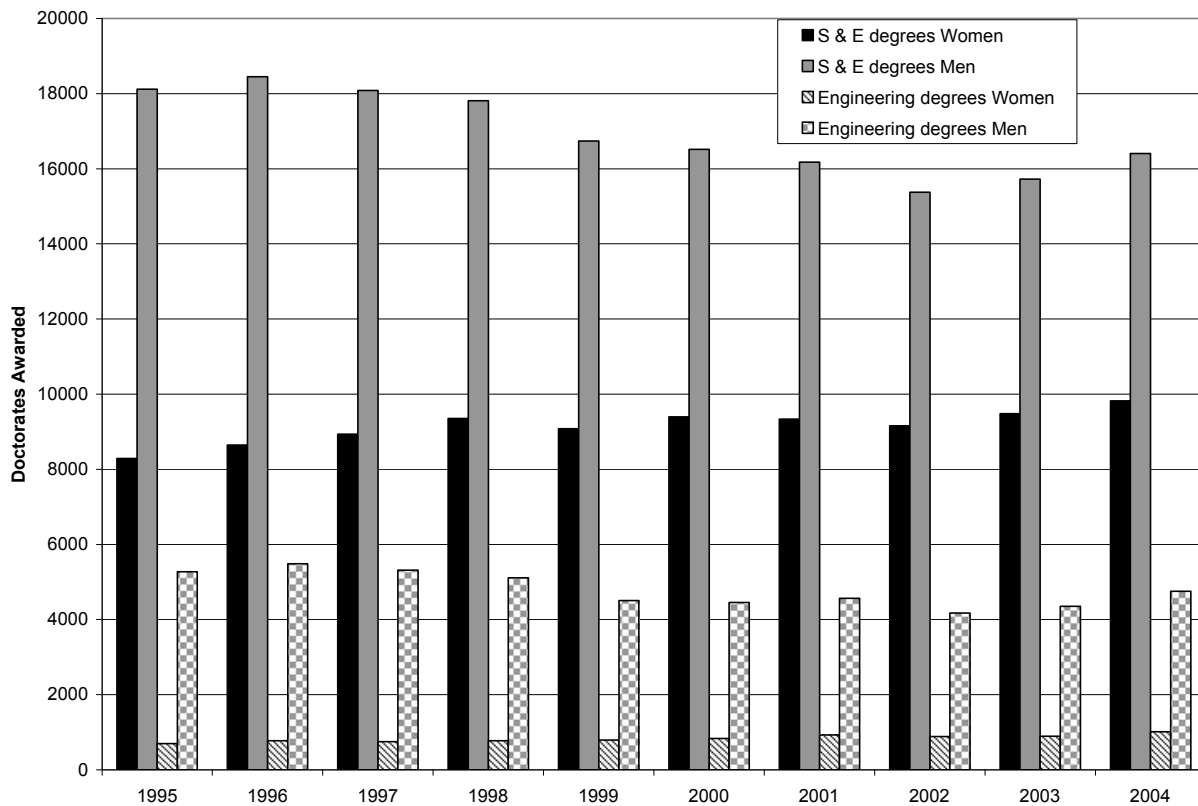


Figure 3. STEM and engineering degrees by gender, 1995-2004

Cultural changes in the United States contributed to these changes in the gender make-up of the science and engineering fields. The first change, the 1964 Civil Rights Act, mentioned sex discrimination in addition to discrimination on racial or ethnic grounds in education and the workplace. The 1972 Title IX legislation banned sex discrimination in any project or institution receiving federal funding. This includes both athletic and academic programs at public education institutions (Barber 1995). Although the federal funding agencies that award grants to educational institutions are charged with checking how well their recipients obey Title IX, few reviews have occurred, mostly due to a lack of coordination across agencies and to a lack of employee hours and funds to effectively evaluate the institutions (United States Government Accountability Office 2004). The legislation also directs the individuals and institutions receiving federal funding to prove that they comply with the law in all funded educational pursuits as well as notifying employees and students of the prohibition of sex discrimination in the academic workplace. In addition, the home institution must determine the appropriate course of action for complaint resolution and must employ one or more Title IX officers. However, the agencies do not compel the grantees to disclose this information, so there is little way to determine if the institutions fully comply with Title IX (United States Government Accountability Office 2004).

A 2004 audit of the Department of Energy (DOE), the Department of Education (DEd), the National Aeronautics and Space Administration (NASA), and the National Science Foundation (NSF) concluded that, although some enforcement of Title IX policy for grantees exists, ongoing scrutiny of the status of women in these institutions does not occur. In general, the federal agencies that fund STEM research react to complaints at and requests for help from their recipient institutions rather than providing more proactive Title IX enforcement reviews (United States Government Accountability Office 2004). However, a lack of filed complaints does not indicate an institution's or individual's compliance with Title IX. Rather, faculty members experiencing discrimination may choose to cope with it rather than complain, fearing retribution during their tenure reviews or simply wanting to focus their time and efforts on their research rather than a potentially lengthy complaint and resolution. Others believe that Title IX applies to athletics only (United States Government Accountability Office 2004). Recently, these agencies have completed reviews of a small number of institutions, focusing on both quantitative (e.g. space, resources) and more subtle (e.g. climate for women) issues (Bhattacharjee 2007).

Because Title IX applies to education, some have argued that science and engineering departments should lose federal funding if the gender distribution of their faculty does not match that of the recent Ph.D. pool in that field (Rolison 2000). Although Title IX compliance does involve quantifiable information regarding the percentage and salary of women in STEM education programs, others believe agencies should examine the context and patterns over time related to the institution's treatment of women (Pieronek 2006). The prevailing culture in science and engineering has a long history of favoring men (Rolison 2000; Barber 1995) and changing the culture will contribute to greater representation of women in these fields. Much research has shown a bias towards rating performance for men higher than that for women, even for identical performance indicators, with the only difference between documents was the name at the top (Martell, Lane, and Emrich 1996). Although the bias is generally found to be small, Martell et al showed via a computer simulation that repeated rounds of promotions giving men even that small bias advantage results in large gender inequity at upper organizational levels.

The Title IX legislation contributed to the increase in women entering and remaining in science and engineering fields, but these fields do not reflect the gender distribution of the general population. For example, one in three STEM students is female, while only one in five STEM professionals is female (Rayman and Stewart 1999), whereas approximately half of the working population across all fields is female (Commission on Professionals in Science and Technology 2004). One reason for the continued underrepresentation of women in these fields may be the design of the legislation itself. Pieronek argues that it focuses too much on the means and the process of moving towards gender equity rather than on the end results of that process. In other words, Title IX asks if institutions are treating women and men equitably from recruitment to retirement, not whether women and men are equally represented and have equal share of resources. However, Title IX would help create supportive environments that might encourage women to pursue higher STEM degrees and ultimately academic employment (Pieronek 2006).

Thus, although many view Title IX as an appropriate tool to improve the gender balance in science and engineering, others disagree and assert that policies in place at federal funding agencies could serve to improve the representation of women in science and engineering. One such guideline is that of the NSF, which requires all applicants to describe how they will create

broad impacts of their work, including reaching out to women and underrepresented minorities (Mervis 2002). However, these broader impacts could be measured in many ways, and with support from the NSF (via DRL-0643048) the Center for the Advancement of Scholarship on Engineering Education (CASEE) of the National Academy of Engineering (NAE) hosted a workshop attended by individuals representing a wide range of NSF directorates and grantee disciplines as well as a range of Carnegie-classified institutions. Both in the workshop and in preparation for the workshop, the attendees identified metrics by which NSF could judge the efforts of its grantees to identify, attract, engage, support, and sustain participation by individuals from populations underrepresented in STEM as well as individuals from institutions underrepresented in NSF-funded activities. These metrics stemmed from both a literature review of existing metrics as well as discussions among working group members. Although the metrics were originally conceived to apply to women, underrepresented minorities, and underrepresented institutions, most could function as Title IX-related metrics as well.

The original metrics applied to different populations and situations, including individuals from populations underrepresented in STEM (i.e., women, minorities, and persons with disabilities), who cannot easily change their status, and individuals from institutions that underparticipate in NSF grant programs (i.e., persons from other than research universities), who theoretically can change their status by changing institutions. The metrics were developed to assess participation of these groups in both research and educational grant activities. In addition, metrics were developed regarding the professional development and progression in academic settings of doctorate holders who are individuals from populations underrepresented in STEM. Finally, metrics were developed to assess efforts by NSF's (individual, multi-investigator, and institutional) grantees to identify, attract, engage, support, and sustain participation by members of underrepresented populations or underparticipating institutions.

These broad metrics could be used in a Title IX context to characterize an institution's current and past gender diversity of the STEM workforce and to encourage the institution to strive for greater gender diversity. The primary focus is on driving greater awareness and commitment to diversity at the institutional level. To that end, colleges and universities are required to file "The Equal Employment Opportunity Higher Education Staff Information Report (EEO-6)" biennially in odd-numbered years with the Higher Education Reporting Committee [composed of the Office of Federal Contract Compliance programs (OFCCP), Department of Education/Office of Civil Rights and the Equal Employment Opportunity Commission]. It details by job category and salary the gender composition of their faculty and staff. The Integrated Postsecondary Education Data System (IPEDS) maintained by the National Center for Educational Statistics (NCES) maintains off-line versions of the EEO-6 reports (National Center for Educational Statistics n.d.). Additionally, as part of their Affirmative Action plans, federal contractors (including most universities and colleges) are required to identify job categories where women are likely to be underutilized, to identify career progressions for these job categories, and to set employment utilization goals based on the calculated "availability" of women given the local population as well as the number of individuals in those fields.

Thus, as a quantitative metric to assess compliance with Title IX, institutions could submit their Affirmative Action plan (including equal employment opportunity information and utilization reports) for public display. Although there will be variation in format and specificity

of the plans developed by institutions, it is possible that the public display of this information will compel greater attention to its preparation and content and that by casting sunshine on these plans, institutional pride and self-interest will compel greater institutional attention to achieving substantive results. By making the plans publicly available, various interest groups should provide summary analyses of the data on employment, retention, and promotion within and between institutions so as to encourage institutional progress. Obviously, the concern should go beyond mere employment to also consider professional retention and progression of women in academic STEM fields.

However, institutions also should be allowed to provide supplemental information on their efforts to comply with Title IX in terms of graduate and undergraduate student participation in STEM. Sample metrics are shown in the appendix, but at the highest level of aggregation such metrics are of the following three types:

1. Comparisons over time of the compositions of the number of women working in the institution,
2. Comparative measures of individual “productivity” at a given point in time for women and men, and
3. The presence/absence of specific “best practices.”

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Appendix

List of sample metrics for Title IX compliance

1. Comparisons over time of the compositions of various populations (with data reported by gender), for example:
 - Overall faculty composition: Composition of STEM faculty by department, institution by rank, tenure status
 - Undergraduate recruitment, matriculation, retention (also by nationality)
 - Graduate student recruitment, matriculation, retention
 - Number and status (full-time, part-time, year in graduate program) of graduate student matriculants in interdisciplinary, cross-disciplinary, and cross-institutional degree programs
 - Postdoctoral student recruitment
 - Percentage of students on scholarship by status (full-time, part-time, year in college)
 - Pre-college and undergraduate research participation
 - Number of student internships, externships, and co-op experiences by status (full-time, part-time, year in college)

- Number of graduate students participating in and attending a local, regional, or national disciplinary meeting
 - Students to state, regional, national disciplinary meetings
 - Average percent of bachelors graduates from department who were transfers from a different type of institution
 - Average number of students employed in STEM workforce over the last five years
 - Average number of baccalaureates on to graduate school/PhD programs over the last five years
 - Average number of baccalaureates on to K-12 teacher programs over last the five years
2. Comparative measures of individual “productivity” at a given point in time for various populations (with data reported by gender), for example:
- Time from BS to MS
 - Time from MS to PhD
 - Time from PhD to postdoctoral
 - Contributions by grant participants (paid time, actual time, level of technological responsibility from 1—10)
 - Number of authored or co-authored papers, journal publications, monographs by graduate students, and undergraduate students in each discipline (if this applies to those involved in the grant); (Other elements to consider: author order, journal quality, citations, scientific responsibility level)
3. The presence/absence of specific “best practices,” for example:
- Developing grant rather than loan programs to fund students
 - School-wide mentoring program (yes/no and level of participation)
 - Cross-institutional mentoring programs
 - Developed alumni tracking program
 - Are there strategic plan commitments/declarations? If so, how are they operationalized?
 - Benchmarking (discipline/department ranking as context for other responses)