Female Participation in ATE-Funded Programs: A Ten-Year Trend

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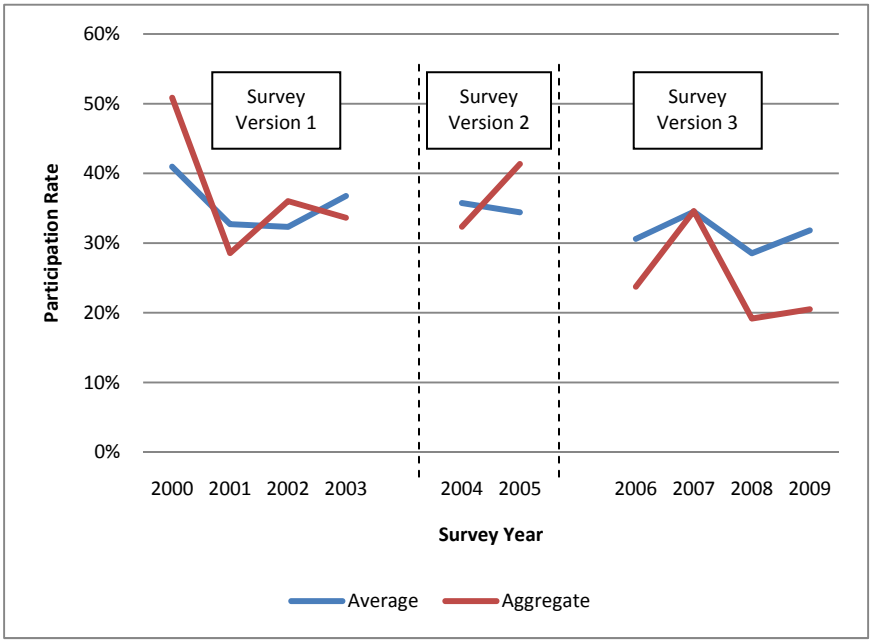
Carl D. Westine, Arlen R. Gullickson & Lori A. Wingate *April 2010*

It is widely known that women are generally underrepresented in STEM disciplines (science, technology, engineering, and mathematics). The National Science Foundation (NSF) Advanced Technological Education (ATE) program has persistently worked to reduce this disparity. For example, the 2000 solicitation specified "increasing the participation of women" as a broader impact that projects should address (NSF, 2000, p. 19). In the current solicitation's section on "Integrating Diversity into NSF Programs, Projects, and Activities, "the importance of including women is noted as part of its attention to the "principle of diversity and deems it central to the programs, projects, and activities it considers and supports," (NSF 10-539, p.16). This briefing paper, which focuses strictly on the ATE program and is based on self-reported data by ATE grantees, represents a starting point for further research on trends in female representation in technology education.

In each of the past ten years, ATE program grantees engaged in program improvement efforts were asked to estimate the percentage of female students in their ATE-supported programs as part of an annual survey of ATE grantees. Between 2000 and 2009, three versions of the survey instrument have been used (see Appendix A for descriptions of the different versions). Respondents' answers were compiled longitudinally to study the participation of women from 2000-09. Figure 1 shows both aggregate (percentage of female students programwide) and average (per-grant mean percentage of female students) participation trends. As this figure shows, the percentage of women in ATE-funded programs declined over the ten-year period, as reported by grantees engaged in program improvement efforts. This decline is evident in both the aggregate and average trends.

Figure 1: Female Participation Rate in ATE Programs



The annual aggregate percentage is the result of summing the number of women across all grants in a given year and dividing that number by the total number of all students reported for that year and multiplying by 100. The annual average percentage is the result of summing the percentages of female students reported by each grantee in a given year and dividing that number by the total number of responding grantees for that year.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Average	41%	33%	32%	37%	34%	34%	31%	35%	29%	32%
Aggregate	51%	29%	36%	34%	32%	41%	24%	35%	19%	21%
Sample Size	38	43	46	72	42	52	37	40	42	34
Std Dev - Average	23%	22%	23%	25%	26%	24%	26%	23%	19%	19%

Female participation data have been disaggregated by education level, with the results shown in Figures 2-5. These figures help to show both the general consistency with and some points of variation from the overall trend. The overall and disaggregated survey findings consistently show women representing less than 40 percent of all

students in ATE programs. Only in 2000 were both the average and aggregate percentages for female participation greater than 40 percent. These findings vary substantially from year to year and appear to be related to several factors, including survey year, grantee target education level, survey version, and sample size. Year-to-year variation is most apparent in the aggregate trend lines. The Figure 1 aggregate line twice changed by more than 15 percentage points from year to year. The per-grant averages tend to be more stable, but in some instances those annual changes were dramatic as well. For example, as shown in Figure 2, female participation at the secondary level in 2007 was above 40 percent, dropped to below 20 percent in 2008, and returned to above 40 percent in 2009.

Figure 2: Female Participation at Secondary Level

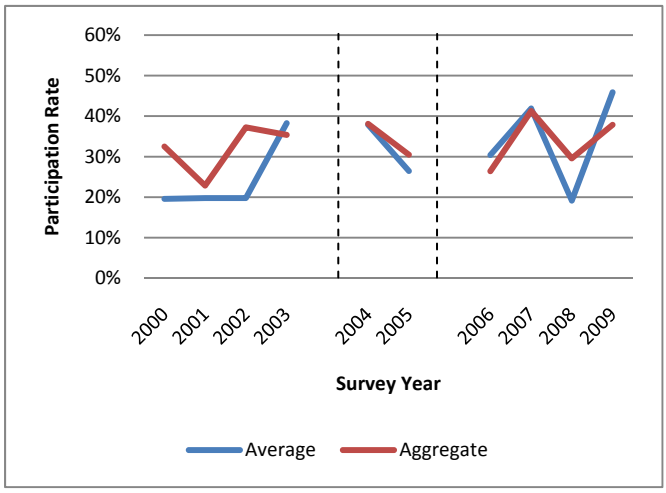


Figure 3: Female Participation at Associate Level

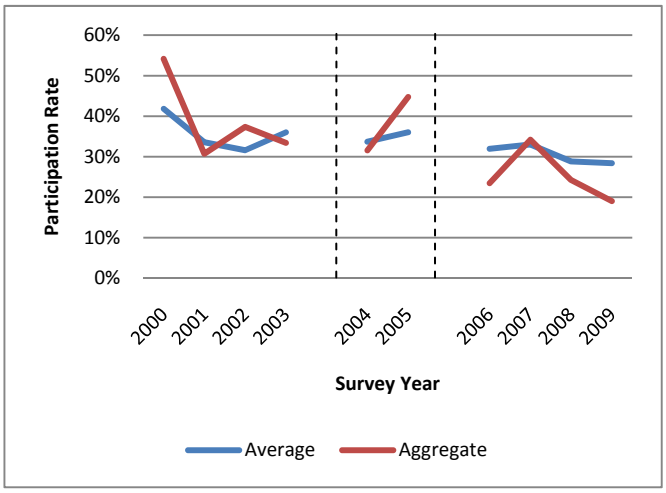


Figure 4: Female Participation at Baccalaureate Level

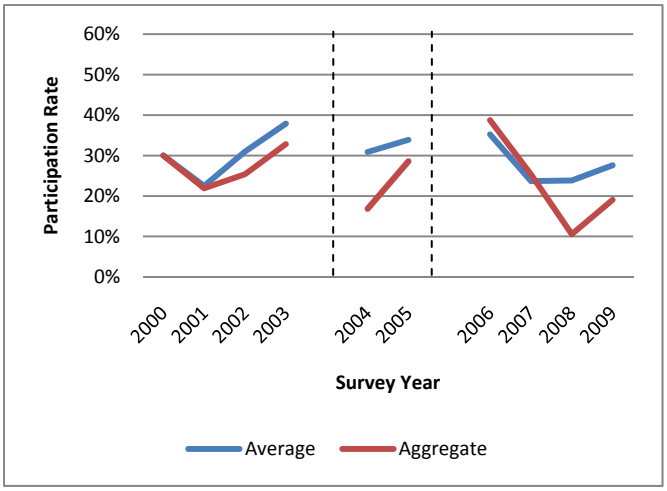
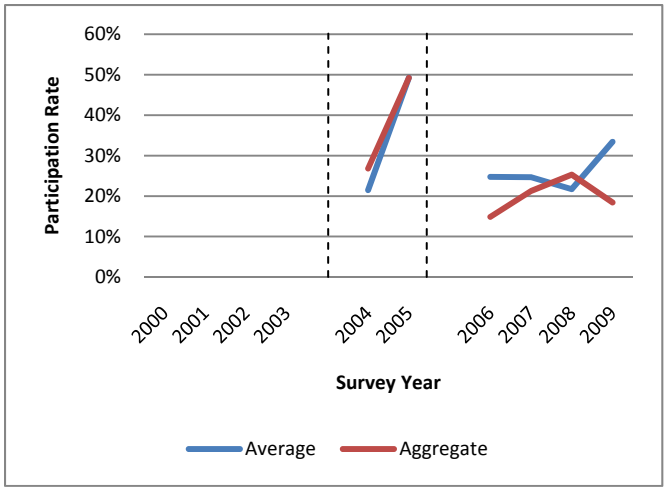


Figure 5: Female Participation in On-The-Job Training



A majority of ATE grantees operate in community colleges—in 2009, 69 percent of ATE grantee institutions were two-year colleges or two-year college systems (see the annual ATE Survey Fact Sheets, available from www.evalu-ate.org/reports). Accordingly, they target the associate degree level in their ATE grant work. Findings for that education level (Figure 3) are consistent with the overall trend shown in Figure 1. From 2000 to 2003, the female participation rate at the secondary school level (Figure 2) generally was lower than that at the associate level. However, more recently, the female participation rate at the secondary level appears to be increasing slightly. Additionally, Figures 4 and 5 show that the female participation rate has remained somewhat flat for baccalaureate and on-the-job training programs.

Interpretation of the average and aggregate trend lines is complicated by changes to the survey form. The three versions of the survey progressively restricted the respondent sample. Version 1 obtained student enrollment information from all

grantees engaged in program improvement efforts. Version 2 gathered data only from those grantees substantially engaged in program improvement efforts. Version 3 solicited student gender information from grantees allotting more than 30 percent of their grant budget to program improvement efforts. Those selection criteria appear to have had a direct bearing on reported numbers of female students. Findings from versions 1 and 2 (years 2000 to 2005) show female participation in the 30 to 40 percent range. Version 3 findings shower lower participation rates for women—much closer to 30 percent for the average and lower yet (e.g., 20 percent) for aggregate findings.

The large within-version variations across years for aggregate percentages are likely partially due to small sample sizes and the fact that a large program with many students can have a significant effect on the aggregate percentage. For example, a grant that serves a large number of students and also has high participation by women may complete their funding period and not be included in the survey sample for the following year. The smaller the sample, the more such variations play a role in the size of the reported percentage of female students. As the documentation in Appendix B shows, the disaggregated samples, especially for education levels other than the associate level are quite small.

As noted in the National Science Foundation's 2006-11 strategic plan, *Investing in America's Future, "*Women, minorities and persons with disabilities remain underrepresented in STEM professions while they are an increasing percentage of the overall US workforce. Alternative and diverse approaches to excellence in education and mentoring create opportunities to tap America's potential" (NSF, 2000, p. 2). This briefing paper offers a glimpse at the representation of women in one NSF-funded education program. The findings raise several questions with regard to women in technology and within the ATE program in particular, such as those below, that could be investigated through more research on this topic:

- Do institutions that receive ATE funding fare better than others in the long run in terms of recruiting and retaining women in their technological education programs?
- Are there ATE-funded programs that have been especially successful in recruiting and retaining women and if so, what has been the key to their successes?
- Are some technological fields more challenged than others in terms of attracting women to their educational programs and careers?
- Although the representation of women shows an overall decline with the ATE program as a whole, how does the infusion of ATE funding impact female recruitment and retention at the institutional level?

Appendix A: Documentation of Survey Versions

From 2000-09 there were three basic versions of the annual survey. Questions about the gender of students are found in Section 6 of the survey, which is about program improvement work. The survey evolved throughout the past ten years so that by 2009, only grantees significantly engaged in materials development, professional development, or program improvement were expected to complete those respective sections of the survey (thereby reducing the overall survey burden). Expectedly, this led to a decline in the percentage of grantees completing the program improvement section.

- *Version 1 (2000-03)*
  Grantees were asked to report the total number of unique students in all programs, and then to select a representative program and report the percentage of female students in that program. For this trend analysis, the percentage of female students in the representative program was used in the calculation of the average female participation rate and to estimate the number of female students in all of the individual grantees' programs. This number was used to estimate the aggregate female participation rate.

- *Version 2 (2004-05)*
  Grantees were asked to self select into the response group that provides gender information based on whether they spent "a significant portion of their annual budget on program improvement." All grantees were asked to report the total number of unique students in all of their programs, and grantees with a significant portion of their annual budget dedicated to program improvement were asked to report the number of unique female students in all of their programs. The total number of unique female students reported was used to calculate the aggregate female participation rate. Each grantee's reported number of female students was used to calculate the percentage of women in their respective programs, and those percentages in turn were used to calculate the average per-grant female participation rate.

- *Version 3 (2006-09)*
  Grantees were asked to provide gender information only if they spent 30 percent or more of their annual budget (or more than $100,000 for ATE Centers) on program improvement. Only grantees meeting the budgeting criteria were asked to report the number of total students in their programs and the number of female students. The number of female students was used to calculate the percentage of female students in the programs with 30 percent or more of their annual budgets dedicated to program improvement, which was used as an estimate of the aggregate female participation rate and to calculate the average per-grant female participation rate.

References

National Science Foundation. (2000). *Advanced Technological Education (2000) program solicitation.* NSF 00-62. Available from http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf0152&org=NSF

National Science Foundation. (2006). *Investing in America's future: Strategic plan FY 2006-11.* NSF 06-48. Available from http://nsf.gov/pubs/2006/nsf0648/nsf0648.jsp

Appendix B: Survey Response Rates and Determination of Sample Sizes

The following five tables identify the sample sizes used in the calculation of female participation rates. Not all grantees who engage in program improvement work serve all educational levels. Therefore, sample sizes by education level are smaller than the overall sample size. Additionally, since some grantees serve multiple educational levels, the sum of sample sizes for all educational levels do not equal the overall sample size.

Some responses were determined to be invalid and therefore excluded from the sample due to inaccurate (e.g. when reported male and female student counts did not sum to total student count) or incomplete (e.g. blank) responses. Only program improvement respondents reporting valid gender data were included in the denominator for calculating the female participation rate for the overall trend (Table 1) and trend by educational level (Tables 2-5).

The number of respondents providing gender data has fluctuated over the past decade. In part, this is a function of the version of the instrument used to solicit this information as well as how individual respondents answered questions about student enrollment and gender in particular. Although not all respondents provided both gender information and total student counts, a reasonable number of grantees significantly focused on program improvement did provide these data. It is possible that programs with little emphasis on program improvement have substantially different female participation in their programs—future investigation into this point is necessary to rule out such a scenario.

Table 1: Calculation of Sample Sizes: All Educational Levels

Overall	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Survey sample	113	81	76	139	158	167	178	171	164	154
Survey respondents	100	75	77	128	154	167	163	163	162	150
Program Improvement respondents reporting…	52	51	51	83	80	90	43	51	50	44
Total unique students										
Total unique students *and* gender data	38	43	46	73	62	69	39	48	49	41
Valid gender data	38	43	46	72	42	52	37	40	42	34
Percentage of Program Improvement respondents reporting valid gender data	73%	84%	90%	87%	53%	58%	86%	78%	84%	77%

Table 2: Calculation of Sample Sizes: Secondary Level

Secondary Level	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Program Improvement respondents reporting…	20	17	16	25	31	25	16	20	21	19
Total unique students										
Total unique students *and* gender data	14	12	12	18	19	15	15	17	18	16
Valid gender data	14	12	12	18	16	13	14	14	16	13
Percentage of Program Improvement respondents reporting valid gender data	70%	71%	75%	72%	52%	52%	88%	70%	76%	68%

Table 3: Calculation of Sample Sizes: Associates Level

Associate Level	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Program Improvement respondents reporting…	48	47	48	76	73	84	36	48	44	35
Total unique students										
Total unique students *and* gender data	33	39	38	68	54	63	33	45	43	33
Valid gender data	33	39	38	64	30	42	29	35	36	25
Percentage of Program Improvement respondents reporting valid gender data	69%	83%	79%	84%	41%	50%	81%	73%	82%	71%

Table 4: Calculation of Sample Sizes: Baccalaureate Level

Baccalaureate Level	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Program Improvement respondents reporting…	7	5	6	16	17	14	9	13	12	12
Total unique students										
Total unique students *and* gender data	1	4	5	9	8	7	9	11	11	9
Valid gender data	1	4	5	9	5	6	9	10	10	7
Percentage of Program Improvement respondents reporting valid gender data	14%	80%	83%	56%	29%	43%	100%	77%	83%	58%

Table 5: Calculation of Sample Sizes: On-The-Job Training

On-The-Job Training	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Program Improvement respondents reporting…	N/A	N/A	N/A	N/A	12	12	3	5	5	7
Total unique students										
Total unique students *and* gender data	N/A	N/A	N/A	N/A	6	3	3	4	5	7
Valid gender data	N/A	N/A	N/A	N/A	4	2	3	3	5	4
Percentage of Program Improvement respondents reporting valid gender data	N/A	N/A	N/A	N/A	33%	17%	100%	60%	100%	57%