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Evaluation of the National Science Foundation Advanced Technological Education Program

ATE Indicators of Productivity: Six-Year Trends 2000-2005

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ATE Indicators of Productivity: Six-Year Trends 2000-2005
Executive Summary

This report presents findings across six annual surveys of Advanced Technological Education (ATE) grantees conducted by The Evaluation Center at Western Michigan University from 2000 to 2005. To create this report, we selected variables for which we had data across this span of years and ones that we believe serve as best descriptors of this program. Our purpose was solely to summarize information provided by ATE grantees about their activity and productivity. In sum, the aggregate information describes important attributes of the ATE program's size, activities, direction, and productivity. Because our purpose was to provide feedback rather than evaluative judgments or guidance, we refrained from making inferences as to what the findings mean or what actions should be taken based on the findings.

This report is intended for use by the National Science Foundation (NSF) in planning program activities, assessing program progress, and preparing annual testimony and reports. ATE grantees may use these findings to assess their own status and learn about the performance of other grantees, which may serve their own improvement needs.

Survey Samples

- The six samples include ATE awardees that had completed at least 1 year of grant activity.
- The number of sampled grantees increased across the span of years, with the largest sample (n = 171) in 2005, which was 66 percent larger than the 2000 sample.
- Response rates were very high and approached 100 percent in 2004 and 2005.

Grantee Characteristics

Because our survey sampled only grantees that had received their grant awards at least one year prior to the survey, the sample characteristics do not fully correspond with NSF figures for the current year. For example, the NSF annual report shows a total of 32 funded centers in 2005, while the survey captured information from a total of 25 centers.

Demographics

- Since 2001, the ratio of ATE projects to centers remained relatively stable, at about 6 projects for every center.
- The number of centers increased over the 6-year span to 25 in 2005, two-and-a-half times the number reported in 2000.
- Centers became much more diverse in audiences, purposes, and funding support across this span of time. For example, ATE added funding emphases for regional centers to support critical technological areas (IT and manufacturing). By 2005, the program included 8 national centers of excellence, 4 regional centers for manufacturing, 6 regional centers for information technology, and 7 resource centers.
- The amount of ATE funding per project was stable across time. However, per center funding declined because of the creation of different types of centers—regional and resource centers received less annual funding than national centers of excellence.

- The program continually emphasized 2-year colleges. The majority of ATE grants (69 to 82 percent across years) were hosted by 2-year colleges. A significant minority were hosted by 4-year colleges (12 to 16 percent). Few were hosted by professional associations (2 to 7 percent) or secondary schools (1 percent).
- The program made awards in 19 technology fields. Information technology, the area in which the program has most concentrated its work and funding, received about one-sixth of all funding for the 6 years. Just over 80 percent of total funding was allocated to 9 fields (including "other" and "interdisciplinary") that individually received 5 percent or more of total funding.

Barriers to Success

Project respondents identified six categories of barriers to project success: (1) resources, (2) students, (3) staff, (4) technological change, (5) communication, and (6) institutional policy. Of the 6 categories, 3 (resources, staff, and students) were identified by at least 30 percent of the respondents in each of the last 3 years:

- Resource-related barriers—such as limited funding, institutional cutbacks, and lack of needed equipment—were identified as by at least 60 percent of the respondents in 5 of the 6 survey years.
- Reports of barriers related to staffing increased across years and were related almost totally to staff turnover.
- Stated concerns regarding students also increased, particularly with regard to deficiencies in students' entry-level knowledge and skills in terms of requisites for successfully participating in and completing technology programs.

Sustainability

Consistently, the most popular means to sustain project work beyond ATE funding was through additional grant funding. Other means (e.g., sale of materials, development of new products, and collaboration with other entities) were also important for many grantees. Institutionalization— bringing the outcomes of the project into the mainstream of the host institution (e.g., by degree or departmental changes)—typically was not viewed as an obvious means for project sustainability. In 2005, less than 10 percent of the respondents identified institutionalization as a sustainability mechanism. However, when provided with a definition of institutionalization and asked directly about related actions, 44 percent of respondents identified actions they had taken to support institutionalization.

Organizational Practices

Work Categories

The surveys identified and sought information about four major ATE work categories: materials development, program improvement, professional development, and articulation agreements. Across the 6 years, these trends were observed:

- A majority of projects engaged in each of the work categories every year; nearly all centers engaged in all work categories.
- The proportion of all grantees engaged in materials development decreased by almost 10 percent to a 2005 level of 66 percent, down from 75 percent reported in 2000.
- The proportion of grantees engaged in professional development and program improvement increased by 16 and 13 percent, respectively, to 83 and 70 percent; by 2005 professional development was the most commonly reported work category.

Workforce Needs Assessment

Data from 2004 and 2005 show that a majority (74 percent or more) of grantees conducted at least one needs assessment.

Advisory Committees

The large majority of grantees (75 percent or more in every year surveyed) used advisory committees. Local and national committees were more frequently used than regional committees.

Evaluation

The large majority (>80 percent) of grantees across all years engaged evaluators—usually external ones. Consistently, a strong majority of respondents (>70 percent) believed their grant-level evaluations were useful and provided data-based evidence of quality.

Monitoring

Survey respondents consistently reported that their NSF program officers interacted with them. E-mail was the principal mode of contact, but the annual PI conference also reached a very large majority of grantees. In general, respondents reported receiving feedback through fewer means in recent years. For example, there were small percentage reductions (9 to 22 percent) in types of interactions used for monitoring (site visits to NSF, site visits by NSF, telephone calls, and e-mail). However, written feedback dropped off sharply—especially in the past 2 years—going from 79 percent of grantees receiving written feedback in 2003 to just over 30 percent in 2005.

These perceptions of NSF were also reported:

- Nearly all respondents (between 94 and 99 percent from 2001 to 2005) viewed NSF program officers as responsive.
- A strong majority also reported that NSF's evaluative actions helped their grants and that NSF facilitated collaborative efforts and understood their project work, although there were fluctuations from year to year in these areas.

Collaboration

Across years, between 90 and 98 percent of grantees reported collaborating with other entities (including other ATE grantees and a variety of other types of organizations) in carrying out their ATE work.

Collaboration with Other ATE Grantees

In 2005, 47 percent of respondents reported collaborations with other ATE grantees. On average, each reporting project indicated 2 to 3 such collaborative efforts. Across the 4 years for which data were available, the percent of grantees reporting collaborations with other ATE grantees decreased by 35 percent.

Collaboration with Non-ATE Institutions

Consistently across the 6 years, large proportions of grantees reported collaborative efforts with non-ATE institutions. Eighty to 90 percent reported collaborations with business and industry and with other educational institutions. Much smaller proportions collaborated with public agencies and with other organizations. The average grantee reported approximately a dozen or more collaborations with other educational institutions and even more with business and industry. Per project numbers of collaborations with business and industry increased slightly over the 6 years, while collaborations with educational institutions declined.

External Support

In 2005, the total added support from external collaborators amounted to more than $34 million, including more than $18 million in monetary support and nearly $16 million in in-kind support. Over the 6-year period, on average each project annually reported receipt of approximately $250,000 of additional support for grant work. External support dropped substantially in 2002 and then increased to pre-2001 levels in 2005. (The extremely large standard deviations for monetary and in-kind support indicate that a few respondents reported receipt of very large amounts, while most received much smaller amounts.)

The various collaborating groups were more likely to provide in-kind support than monetary support. For most groups, the number providing in-kind support was more than double those listed for monetary support. Most in-kind support tended to come from business and industry. For example, in 2005 the average project reported 13 business and industry collaborators (versus 10 educational institutions) that provided in-kind support. (Again, standard deviations were extremely large, more than double the average values in the case of business and industry.)

Most Effective Collaborators

Other education institutions were identified as the most effective type of collaborator, followed by business and industry.

Materials Development

Productivity

In sum, more than 5,000 materials were produced across the 6 years, including approximately 1,600 courses, 2,500 modules, and 1,100 other types of materials. The proportion of grantees engaged in materials development first increased and then decreased over the 6-year period. Initially recorded at 75 percent participation, the proportion increased to 84 percent in 2002 and then dropped to 66 percent in 2005. Results for materials developed followed similar patterns, with more products produced earlier and fewer most recently. By 2005, the total number of materials completed annually had dropped to 462—down more than 50 percent from the year 2000 total of 1,055. The declines may be a reflection of the ATE program's increasing emphasis on funding efforts that would result in materials developed for "national dissemination." The 2002 program solicitation was the first to specify that funding for materials development was intended to support the creation of materials that would be "published for national distribution." Prior to that, the solicitations indicated materials should be "widely disseminated."

About the same number of grantees engaged in development of courses and modules; far fewer developed other types of materials. Projects tended to produce more modules than courses; the ratio varied substantially across the 6 years, but in 3 of the 6 years, the ratio was at least 5 modules for every 3 courses completed.

Development Practices

In developing materials, the large majority of grantees reported verifying alignment of materials with workforce needs and/or used student or industry standards as development guidelines. Across all years, at least 70 percent of those engaged in development reportedly used one or both practices. Similar proportions indicated use of pilot trials and internal field tests to improve their materials, but far smaller proportions employed external field trials (e.g., 45 percent in 2005). In 2000, 2001, and 2003, most respondents reported that they obtained comparisons of student results against industry standards, but the proportion making such efforts dropped by half to 31 percent in 2005. The proportion that reported making student achievement comparisons of their curriculum against competitor curricula was not high in any year; it was highest (44 percent) in 2000 but declined to 29 percent by 2005.

Dissemination

With regard to the dissemination (i.e., use locally and/or elsewhere and commercial publication) of materials produced with ATE support, respondents indicated that most use occurred at the local level—in total, more than three times as many courses were used locally as those that were used elsewhere or published commercially. Module use was more widespread, with slightly more being used elsewhere than locally. Almost twice as many "other" types of materials were used elsewhere as locally. More than 500 modules and other materials were reported to have been published commercially, compared with 135 courses.

Professional Development

Numbers and Types of Professional Development

In 2005, a total of 2,195 professional development activities were offered by ATE grantees, including event-based programs (e.g., workshops and conferences), events with follow-up activities, internships, self-study, and other longer-term activities. Annually, the number of event-based professional development activities was substantially larger than other types. Additionally, the number of grantees engaged in event-based activities tended to be at least twice that for other activities.

Participation

Overall the grantees reported more than 80,000 participants in the various professional development activities. Participation increased across years for all three types of institutions— secondary schools and 2- and 4-year colleges. The number of annual participants more than doubled at the associate-degree level to more than 9,600. The number of secondary school participants increased more than six-fold to more than 15,600; participation at the baccalaureate level increased more than five-fold to nearly 2,800.

Over all 6 years, 44 percent of participants were from secondary schools, 45 percent from associate-degree level colleges, and 11 percent from baccalaureate institutions. In the first year surveyed, 60 percent of professional development participants were from associate-degree level institutions. By 2005, associate-degree faculty comprised just a third of the total participants, with secondary school faculty being the primary audience for these activities.

Impact

Grant-level reports of evaluation and follow-up provided three main findings:

- Respondents reported consistently high levels of participant satisfaction with various professional development activities. For example, they reported that 85 percent or more of participants were satisfied with professional development *events*—and the results are comparable for other types of professional development formats, such as internships and events with follow-up.
- Fewer (60 percent) participants used ideas and information from professional development events.
- Few grantees actually followed up to learn about implementation efforts on the part of participants and whether those efforts resulted in improved student achievement (in 2005, for example, 69 grantees reported on participant use and 31 reported on student achievement impact, compared with 107 grantees who reported on satisfaction) The results were better for longer-term professional development programs (higher proportions followed up and reported student improvement), though fewer grantees provided this types of professional development.

Program Improvement

In 2000, 57 percent of grantees reported program improvement activities. That proportion
increased to 68 percent in 2001 and held nearly steady, with 70 percent reporting activity in this
area in 2005. From 2000 to 2005, respondents reported the following accomplishments related to
program improvement:

- Created and/or improved more than 3,000 programs
- Created or revised a total of more than 17,000 courses
- Engaged an average of more than 60,000 students at more than 800 locations per year

Across the 6 years emphases changed in several ways:

- The number of programs developed or changed increased substantially, increasing by more
  than 300 to the 2005 level of 690.
- The number of courses being developed or changed dropped substantially in the 2 most
  recent survey years; in 2005, course changes numbered almost 2,000—less than half the
  number reported in 2000.
- The number of students reached varied substantially by year and showed no clear trend.
- The number of locations included in program development efforts more than doubled across
  the 6 years to more than 1,100 places in 2005.

Productivity

The greatest program improvement productivity occurred consistently at the associate-degree
level. Associate degree institutions played a major role both in terms of numbers of grants and
measures of their productivity.

- The number of grantees engaged in program improvement based at associate-degree
  institutions was 2 to 3 times that of secondary schools and 6 to 7 times greater than
  baccalaureate institutions and on-the-job programs.
- Programs produced for associate degree programs outnumbered secondary and baccalaureate
  programs by factors of 3 and 13, respectively (2,066 versus 787 and 162). Almost 100 on-
  the-job programs were developed in 2004 and 2005.
- Courses produced for associate-degree programs outnumbered courses produced for
  secondary and baccalaureate programs by factors of 11 and 20, respectively (16,842 versus
  1,534 and 848). In 2005, the number of courses produced or revised for the associate-degree
  level nearly equaled the number produced across all 6 years for the secondary level and
  doubled the total for the baccalaureate level.
- Students reached at associate-degree programs outnumbered students reached at secondary
  and baccalaureate programs by factors of 7 and 48, respectively (324,391 versus 48,966 and
  6,827).

Articulation Agreements

The articulation agreements track focused on three transition points. From 2004 to 2005, more than 2,000 agreements were made to address these transition points. Most agreements (1,479) affected the high school to 2-year college point, and the fewest (87) focused on 2-year colleges as feeder points for teacher preparation in the area of technical education.

Survey findings suggest that agreements for technician articulation would serve students matriculating to one or two specific second institutions. However, for teacher preparation, for every one agreement, there were three to four different institutions involved. In 2005, there were 175 institutions involved in 53 agreements for teacher preparation; in 2004, the numbers were 139 and 34, respectively. This suggests that each 2-year college engaged an average of three or four separate 4-year colleges in each articulation agreement. In such situations, a student completing the teacher preparation portion at a 2-year college could choose among multiple baccalaureate institutions to complete the teaching program.

Student and Workforce Impact

Demographics

At 35 percent in 2005, the 6-year trend showed no rate gain in women's participation. There were modest overall gains in participation (e.g., 5 to 10 percent) by Hispanic/Latino and American Indian/Alaska Native populations. There were fluctuations in the participation rates of African Americans, with a low of 11 percent in 2003 and a high of 25 percent in 2004. However, the 19 percent rate reported in 2005 is just 2 percent more than the 2000 rate of 17 percent.

Outcomes

Student enrollment in ATE-supported programs greatly increased at the secondary school level, increasing about five-fold from 2000 to 2005. There were even larger increases in enrollments at the associate degree level—in 2005, it was more than 15 times the size of the enrollment in 2000. There was considerable fluctuation in enrollments at the baccalaureate level over the years.

Program success in terms of retention of enrolled students has been high. At the associate level, it was reported that annually between 4 and 16 percent of students left programs prior to completion; at the baccalaureate level, between 0 and 8 percent left.

Findings showed that students who completed secondary and 2-year college programs were highly likely to continue a STEM or technician course of action. In most years, 90 percent or more of students who completed programs at 2-year colleges were reported to either be employed as technicians or continuing their STEM education. Students who completed secondary school technician programs were much more likely to continue their STEM education than to become employed as technicians.

*Major elements of this synthesis have been organized into a two-page document called **ATE Survey Highlights 2000-2005**, which addresses the elements of the ATE program identified in its 2005 annual solicitation (National Science Foundation, 2005). **That document is appended to the Six-Year Trends main report.***

ATE Indicators of Productivity:
Six-Year Trends 2000-2005

This report presents findings across six annual surveys of Advanced Technological Education (ATE) grantees[1] conducted by The Evaluation Center at Western Michigan University from 2000 to 2005. These surveys collected data from ATE grants that had been operating for at least 1 year at the time the survey was conducted—usually between February and April each year. Our purpose in creating this report was solely to summarize information provided by ATE grantees about their activity and productivity. As such, we refrain from making evaluative judgments and inferences as to what the findings mean or what actions should be taken based on the findings. In sum, the aggregate information describes important attributes of the ATE program's size, activities, direction, and productivity.

This report's findings are intended to be useful to the National Science foundation (NSF) in planning program activities, assessing program progress, and in preparing annual testimony and reports. ATE grantees may use these findings to assess their own status and learn about the performance of other grantees, which may serve their own improvement needs.

The aims of the ATE program have been consistent across this span of time and are reflected in this 2005 synopsis of the program:

> With an emphasis on two-year colleges, the Advanced Technological Education (ATE) program focuses on the education of technicians for the high-technology fields that drive our nation's economy. The program involves partnerships between academic institutions and employers to promote improvement in the education of science and engineering technicians at the undergraduate and secondary school levels. The ATE program supports curriculum development; professional development of college faculty and secondary school teachers; career pathways to two-year colleges from secondary schools and from two-year colleges to four-year institutions; and other activities. A secondary goal is articulation between two-year and four-year programs for K-12 prospective teachers that focus on technological education. Additionally, the program invites proposals focusing on applied research relating to technician education. (National Science Foundation, 2005)

Survey findings have been organized to describe the status and trends of this program from 2000 to 2005. Readers of the report should be able to determine answers to questions such as these:

- To what extent and in what ways did the program emphasize 2-year colleges?
- With whom did ATE grantees partner to promote improvements in technology education at undergraduate and secondary schools and what were some of the characteristics of these partnerships?
- What materials have been developed, what steps were taken to assure high quality of these materials, and how widely have they been distributed?
- What was the nature of program improvements undertaken and how big an impact have these improvements made?

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[1] In this report, the term "grantee" is used to refer to the ATE grantees—including projects, centers, and articulation partnerships—that responded to the annual evaluation survey.

- What is the extent and nature of professional development activities undertaken by grantees?
- What educational pathways are being opened for students in technology education crossing secondary, 2-year, and baccalaureate institutions?
- What actions do grant recipients and NSF program officers take to ensure quality and progress in program activities?

Productivity Indicators

In keeping with earlier annual survey reports, this 6-year trend report presents results according to survey domains, as depicted in Figure 1. Information for the first three domains—grantee characteristics, organizational practices, and collaboration—were routinely gathered from all respondents. Information pertaining to the next four domains—materials development, professional development, program improvement, and articulation agreements—was gathered just from grantees that engaged in those types of activities. Each respondent was expected to complete those sections that matched their grant activities. Information pertinent to the final domain—student and workforce impact—was drawn from questions contained in the program improvement section of the survey. This approach was based on the expectation that the impact of materials and professional development efforts would be visible through assessment of the program improvement efforts.
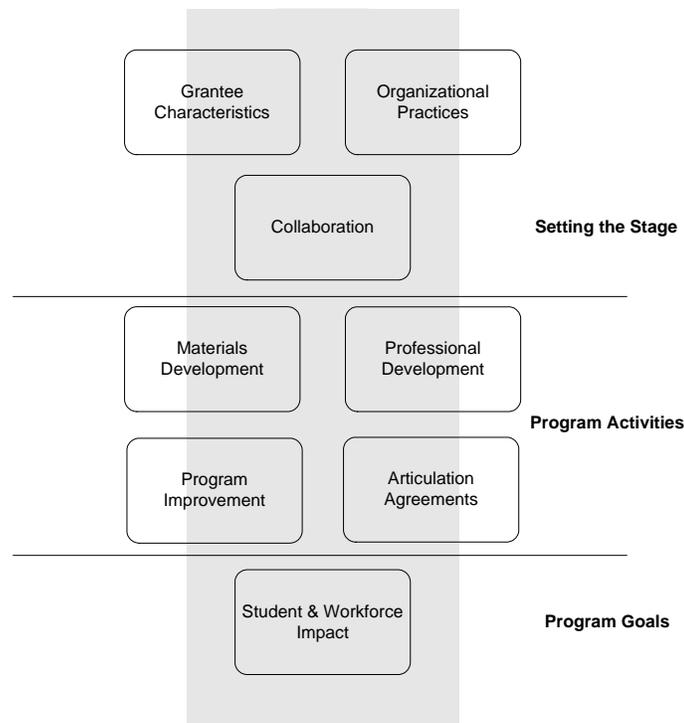
Figure 1. ATE survey domains

Generally, the framework for the survey and wording of individual questions remained consistent across years. However, each year small changes were made for specific items. Where the changes affect table findings, they are noted within the tables. In 2004, several organizational changes were made to the survey. Those changes more directly impacted reported results. Three key aspects of those changes include the following:

- Two survey sections labeled "Principal Investigator's Overview" and "Monitoring" were removed from the survey. The items contained in these sections were either eliminated or moved to a new section called "Organizational Practices."
- The "Collaboration" section, which was previously optional, became a required section.
- Prior to 2004, the program improvement domain comprised three separate program improvement sections—one each for the secondary, associate degree, and 4-year degree institutions. In 2004, these sections were combined into one "Program Improvement" section, and items regarding workplace training were added to reflect grantee activity in this area.

Despite these changes, the trends reported in this report are based on indicators that have remained largely consistent across the six survey years. Table 1 summarizes the indicators reported for each survey domain. Appendix A contains detailed descriptions of these and other indicators about which data were collected.

Table 1. ATE Program Indicators

Survey Domain	Indicators
1.0 Grantee characteristics	1.1 Demographics 1.2 Barriers to success 1.3 Sustainability
2.0 Organizational practices	2.1 Work categories 2.2 Workforce needs assessment 2.3 Advisory committees 2.4 Evaluation 2.5 Monitoring
3.0 Collaboration	3.1 Collaborations with other ATE grantees 3.2 Collaborations with non-ATE institutions 3.3 External support 3.4 Most effective collaborators
4.0 Materials development	4.1 Productivity 4.2 Development practices 4.3 Dissemination
5.0 Professional development	5.1 Productivity 5.2 Participation 5.3 Impact
6.0 Program improvement	6.1 Productivity
7.0 Articulation agreements	7.1 Productivity 7.2 Impact
8.0 Student impact	8.1 Demographics 8.2 Outcomes

Survey Sample

Each year, grants that had completed at least one year of grant funding *and* were still active at the time the survey was administered were invited to participate in the annual survey. The rationale for this sampling rule was that grantees needed at least one year of activity in order to be able to reasonably report on productivity.

In more recent survey years—from 2003 to 2005—defining this sample has become more complicated due an increasing number of continuation grants, which are new grants (i.e., they have new NSF award numbers) that extend the work of a prior grant. To determine whether a particular grant represented a completely new effort or a continuation of previous work, we noted the institution, principal investigator and co-principal investigator(s), and title of the grant. We then consulted with the principal investigators and NSF program staff to confirm or reverse our judgments based on that information. Those grants that were confirmed to be new and had been in operation less than 1 year were not included in the sample. Continuation grants were included since they extended previous grant activity.

Table 2 shows the number of active grants, number of grants in the survey sample, and number of grantees that responded to the annual survey, as well as annual response rates. These figures reflect the sample rules described above and show that overall the survey has attained a high response rate over the years. These figures also reflect a steady increase in program size, with the number of active ATE awards more than doubling between 2000 and 2005.

Table 2. ATE Survey Sample and Response Rates

	2000	2001	2002	2003	2004	2005
Active grants	114	123	200	220	220	248
Sample size	113	81	77	139	158	171
Respondents	100	75	77	128	154	167
Response rate	88%	93%	100%	92%	97%	98%

1.0 Grantee Characteristics

This section addresses factors related to grantee demographics (e.g., types of institution funded), barriers to success, and sustainability.

Because our survey sampled only grantees that had received their grant awards at least one year prior to the survey, the sample characteristics do not fully correspond with NSF figures for the current year. For example, the NSF annual report shows a total of 32 funded centers in 2005, while the survey captured information from a total of 25 centers.

1.1 Demographics

From 2000 to 2005, the ratio of ATE projects to centers remained relatively stable, as shown in Table 3. Within this overall stability, two developments changed the overall character of the program: the creation of a third program track for articulation partnerships and modification of centers' size and purpose. Until 2003, articulation partnerships were included within the

category of projects. As the 2003 column shows, the percent of projects declined almost exactly by the percent of newly classified articulation partnerships. Articulation partnerships were essentially specialized projects designed to focus specifically on establishing pathways for students between education levels.[2]

Table 3. Grantees by Program Track

	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Projects	90%	85%	88%	86%	81%	82%
Centers	10%	15%	12%	12%	14%	15%
Articulation partnerships	-	-	-	2%	5%	3%
Respondents (n)	100	75	77	128	154	167

The number of centers grew in a manner consistent with the overall program's growth, but there was increasing specialization in terms of the focus of center efforts. In 2004, the survey was modified to permit tracking different types of centers. Although there are not large differences in the number of awards for the various types of centers, it should be noted that individual regional centers and resources centers are funded at lower levels than national centers—in 2004, for example, awards for national centers could be up to $5 million over four years, while regional centers could receive up to $3 million, and resource centers up to $1.5 million (National Science Foundation, 2004).

Table 4. Grantees by Center Type

	2004	**2005**
National center of excellence	43%	32%
Regional center for manufacturing	5%	16%
Regional center for information technology	33%	24%
Resource center	19%	28%
Respondents (centers only) (n)	21	25

As shown in Table 5, and consistent with ATE program guidelines, the majority of grants (ranging from 69 to 82 percent over the years) are hosted by 2-year colleges and a significant minority are hosted by 4-year colleges (12 to 16 percent). Few (<1 percent) are hosted by secondary schools and professional associations.

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[2] Most findings in this report focus on all grantees or particularly on projects or centers.

Table 5. Grantees by Host Institution Category

	2000	**2001**	**2002**	**2003**	**2004**	**2005**
4-year college/university	12%	13%	16%	16%	15%	16%
2-year college	82%	75%	70%	69%	76%	76%
Association/society	2%	3%	5%	7%	3%	4%
Secondary school	1%	1%	1%	1%	1%	0%
Other	3%	8%	8%	8%	5%	4%
Respondents (n)	100	75	77	128	154	167

Table 6 shows that the award amounts remained relatively stable across all 6 years. Grantees were asked to provide their "Current total award amount." The amount reported might be the result of a continuing or standard grant. Across all years, roughly one-fourth of grantees reported receiving awards in each of the four categories: less than $300,000; $300,000 to $499,999; $500,000 $849,999, and greater than $850,000.

Table 6. Total Award Amounts

	2000	**2001**	**2002**	**2003**	**2004**	**2005**
$0 - $299,999	24%	21%	17%	21%	23%	25%
$300,000 - $499,999	24%	25%	22%	25%	27%	20%
$500,000 - $849,999	29%	24%	31%	31%	31%	28%
$850,000 +	23%	29%	30%	23%	20%	26%
Respondents (n)	100	75	77	128	154	167

As shown in Table 7, the majority of ATE grantees had been funded for between 1 and 3 years at the time of the annual surveys. This table reflects the increase in continuation grants in operation less than 1 year from 2003 to 2005. These continuation grants in conjunction with mature grants (more than 3 years old) combined to make up 40 percent of all grants in 2005.

Table 7. Age of Grants at Time of the Survey

	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Less than 1 year[a]	34%	19%	14%	3%	5%	16%
1 - 2 years	30%	44%	48%	59%	35%	34%
2 - 3 years	24%	28%	33%	27%	45%	27%
3 - 4 years	8%	1%	4%	9%	14%	22%
4 or more years	4%	8%	1%	2%	2%	2%
Respondents (n)	100	75	77	128	154	167

Respondents were asked to identify the major emphasis of their grant work. They reported emphases in 18 specific technology fields plus some "other" and "multidisciplinary" types of grant work.. Table 8 shows the distribution of grants across fields and percent of total funding for each of these fields, in descending order. Funding was spread across all of the fields. Information technology, the area in which the program most concentrated its work and funding, received

approximately a sixth of all funding for the 6 years. Just over 80 percent of total funding was allocated to 9 fields, which include "multidisciplinary or interdisciplinary" and "other" that individually received 5 percent or more of total funding.

Table 8. Distribution of Active Grants Across Fields

Technology Field	2000	2001	2002	2003	2004	2005	Row total	Percent of total funding
Information technology, telecommunications	10	10	16	24	21	20	101	17%
Semiconductor manufacturing	2	10	3	3	5	35	58	10%
Engineering technology (general)	6	8	5	10	13	6	48	9%
Manufacturing & industrial technology	14	10	9	16	18	3	70	9%
Other (specify)	6	1	1	10	33	-	51	9%
Multidisciplinary or interdisciplinary (general)	13	2	8	18	12	4	57	8%
Biotechnology	6	4	8	11	8	10	47	7%
Geographic information systems	5	1	-	1	2	35	44	7%
Environmental Technology	9	6	6	10	6	2	39	5%
Chemical technology	5	6	4	4	5	3	27	3%
Electronics, instrumentation, laser, & fiber optics	2	1	3	4	3	12	25	3%
Mathematics	2	1	1	7	8	3	22	3%
Agriculture	1	-	2	4	4	2	13	2%
Marine technology	2		1	1	1	14	19	2%
Physics	8	5	1	1	5	2	22	2%
Distance learning	1	2	-	-	-	7	10	1%
Machine tool technology, metrology	4	1	5	1	1	3	15	1%
Transportation	1	3	2	1	2	-	9	1%
(No response)	-	-	-	-	4	5	9	1%
Aquaculture	2	2	1	2	1	1	9	0%
Graphics & multimedia technology	1	2	1	-	2	-	6	0%
Column total	100	75	77	128	154	167	701	100%

1.2 Barriers to Success

Analyses of responses regarding barriers to project success led to identification of six relevant categories: (1) resources, (2) students, (3) staff, (4) technological change, (5) communication, and (6) institutional policy. Of the six categories, three (resources, students, and staff) were identified by at least 30 percent of respondents in each of the last three years.

- Resource limitations were identified as a barrier to success by at least 60 percent of respondents in 5 of the 6 survey years.
- Problems related to staffing have increased across years and relate almost totally to staff turnover.
- Stated concerns regarding students have also increased. Such concerns focused on deficiencies in students' entry-level knowledge and skills in terms of requisites for successfully participating in and completing technology programs.

In summarizing these data, it was apparent that these themes were not discrete. For example, issues of communication and coordination often overlapped with staff or institutional policy issues. In these cases, a particular statement was subjectively coded according to the dominant idea represented. Table 9 presents the results of this analysis.

Generally, the types of barriers faced by ATE grantees stayed the same from 2000 to 2005. Resource issues, such as limited funding, institutional cutbacks, and lack of needed equipment, were consistently identified as barriers to success.

In more recent years, staffing has emerged as one of the most critical issues. Staff turnover due to faculty attrition, department and college restructuring, and staff leaving for the private sector all impede the ability of ATE grantees to establish and maintain successful technological education programs.

Table 9. Proportion of Grantees Reporting Various Barriers to Success[a]

	2000	2001	2002	2003	2004	2005
Resources	60%	25%	71%	65%	63%	59%
Students	-	10%	13%	34%	26%	26%
Staff	18%	19%	29%	42%	38%	31%
Technological change	24%	21%	13%	17%	11%	18%
Communication & coordination	16%	16%	54%	38%	22%	19%
Institutional policy	27%	24%	9%	30%	22%	19%
Respondents (n)	100	75	76	127	151	164

[a] Categories and associated percentages were derived from a qualitative analysis of open-ended questions.

Selected verbatim participant responses that elaborate the nature of barriers faced by ATE grantees are presented below.

Resources:
- *Lack of resources and competing requests for support*
- *Additional funding from public and private sectors*
- *Inadequate funding of technical/labor support due to acceptance of reduced budget*
- *Limited equipment dollars—additional funds are needed to acquire equipment necessary to prototype new laboratory exercises*
- *High costs of materials and maintenance of labs*
- *Cutbacks for equipment and supplies*

Students:
- *Student recruitment and students transferring before they finish the program*
- *Skills of incoming students have been below standards and have required bridge programs/remediation efforts prior to students being fully accepted into the program*
- *Attracting academically prepared students for the rigor of the A.S. degree program*
- *Actively promote to women how to become involved, what is expected (and what is not assumed), and the potential benefits*
- *Students are not academically prepared for technical training programs*

Staff:
- *It is very hard for long-time lecture-based faculty to change their view of how learning occurs.*
- *Lead teacher cohort stability (faculty attrition)*
- *The difficulty of keeping a good tech writer. The market pays them much more than the project can pay*
- *Turnover of staff and faculty within our department and within our college has challenged our efforts to create a stable program.*
- *Instability of teachers and other staff*
- *Faculty leaving for private sector*

Technological change:
- *Teachers resistant to learning or adapting new technologies*
- *Rapid changes in the field that complicate the curriculum and curriculum change process*
- *Faculty not current in technology needing more "instruction" when we thought they would be contributors*
- *Telecommunications technology changes very rapidly and so does the related equipment for learning.*
- *Difficulty in keeping up with changes in discipline*
- *Staff resistance to learning new technologies*

Communication:
- *Collaborative partners not completing projects in a timely manner*
- *Coordination of materials development projects*
- *Some of the partner colleges have not forged close ties with local "mentor" firms as we have encouraged them to do*

- *The difficulty of coordinating between organizations has resulted in misconceptions of assigned tasks*
- *Due to the nature of our project we have encountered major problems in our internal communication procedures.*
- *Communication between our partners has been erratic and confusing.*

Institutional policy:
- *Lack of administrative support at the local high schools*
- *Lack of support from administration, not enough space on campus, internal issues between staff, lack of department support*
- *Lack of buy-in by college/department to obligations of the project*
- *New accountability testing in high schools makes it harder to implement a new curriculum that isn't directly tied to those tests.*
- *No real support from our host institution has caused major problems.*
- *Enrolling students is increasingly difficult due to changes in financial aid and application procedures.*

1.3 Sustainability

Beginning in 2002, survey respondents were asked to describe their plans for sustainability. To enable a longitudinal analysis, responses across survey years were coded according to five themes: (1) funding, (2) dissemination of products, (3) development and modification of existing products, (4) institutionalization at the host institution, and (5) collaboration or partnerships with other organizations.

Table 10 presents the results of this analysis. As shown, obtaining additional funding was the most frequently reported strategy for sustaining grant activities. Grantees reported that they would seek additional funding from ATE or other NSF sources, as well as from other local, regional, or national sources.

Sustainability through development and modification, however, suggests a slightly different perspective. Rather than sustaining grant activities through continued external funding, product development suggests that the work of the grant may be sustained by the host institution and/or other organizations adopting all or pieces of the current work. In this way, ideas, content, and approaches are sustained though the grant itself may no longer operate.

Consistently, the most popular means for sustaining grant work beyond completion of the ATE funding period is seeking additional grant funding. Other means (e.g., sale of materials, development of new products, and collaboration with other entities) are also important for many of the grantees. Institutionalization, which reflects the project's intention to integrate grant outcomes into the larger institution, was the least reported strategy for sustainability. With the exception of 2002, consistently less than 10 percent of respondents identified institutionalization as an approach for sustainability. However, when provided with a definition of institutionalization ("incorporating the use of products . . . produced by your project/center/partnership into your funded and/or other institutions") and then asked to describe

plans for institutionalization, 44 percent of respondents described actions that could be characterized as institutionalization.

Table 10. Proportion of Grantees Reporting Various Plans for Sustainability

	2002	**2003**	**2004**	**2005**
Funding	47%	37%	36%	42%
Dissemination	16%	33%	25%	23%
Development/modification	25%	21%	28%	19%
Institutionalization	34%	9%	4%	8%
Collaboration/partnership	20%	21%	20%	25%
Respondents (n)	76	127	151	164

Below are examples of the individual responses from each of the five categories of sustainability efforts. These comments provide more detail about respondents' intentions and elaborate and clarify the nature of responses to the question of how grant work will be sustained.

Funding:
- *Submit an ATE grant for years 7-10 and have plans to submit other grants through other funding sources.*
- *As has been done in the past, NSF funding will be sought to continue main functions of the project.*
- *Contacting and applying for funding locally, regionally, and nationally.*
- *We will continue to seek external funding.*

Dissemination:
- *Market identified products: textbooks, academic workshops, and corporate training.*
- *Project will be sustainable through revenue generated through sales of product, registration fees for institutes, and access and troubleshooting fees.*
  Selling products developed by our project.
- *Making our courses available via the Internet.*

Development/Modification:
- *Three new courses have been developed and offered this past academic year.*
- *The project will be sustained by way of continuing to offer newly developed courses.*
- *We are in the process of updating our current courses making them available to a wider audience.*
- *Developing materials which will generate funds for the project.*

Institutionalization:
- *It is believed that the curriculum will become institutionalized and that the call to continue the program (from industry) will drive this.*
- *Institutionalize the courses we're developing for middle school mathematics education majors.*
- *The current courses are in the process of institutionalization.*

Collaboration:
- *Participating institutions have formed alliances with each other and other educational institutions and business partners that will continue beyond the scope of the project.*
- *Institutions have formed alliances and collaborations with each other and with business partners.*
- *Partnering with local industries.*
- *We hope to extend our collaborative networks so that we have a stronger local impact and to continue the project beyond our current funding.*

2.0 Organizational Practices

Organizational practices indicators are intended to describe the operations and activities of ATE grantees. These indicators include the following: engagement in various ATE work categories (e.g., materials development and professional development), workforce needs assessments, advisory committees, evaluation practices, and NSF monitoring. Overall, these indicators are suggestive of the extent to which grantees were focused in their work, were rigorous in their approach to work, and sought to continually improve their operations and activities.

2.1 Work Categories

The primary ATE work categories are defined in Table 11. Grantees were asked to complete those survey sections that matched their grant's activities. In analyzing the responses, we treated a response to one or more of these survey sections as an indication that the grantee was significantly engaged in that activity.

Table 11. ATE Work Categories

Work Category	Definition
Materials Development	the creation, adaptation for implementation, and/or testing of courses, modules, process models, and/or other instructional or assessment units.
Program Improvement	refers to multiple, related courses and/or field experiences for students at designated education levels (i.e., secondary school, associate, or baccalaureate) that lead to a defined outcome such as a degree, certification, or occupational completion point.
Professional Development	focuses on instruction and/or support provided to teaching faculty and staff to update their knowledge and skills and to train them to teach new or improved curricula effectively
Articulation Agreements	specific agreements that allow students who complete an education program or series of courses to matriculate to a higher level of education at specified institutions.

As indicated in Table 12, across the 6 survey years, the following patterns emerged with regard to work categories:

- Most grantees engaged in all work categories every year.
- The proportion of grantees engaged in materials development decreased by approximately 10 percent to a 2005 level of 66 percent .
- The proportion of grantees engaged in professional development and program improvement increased; by 2005, professional development was the most commonly reported category.

Table 12. Proportion of Grantees Reporting Activity in Various Work Categories

	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Materials development	75%	82%	84%	77%	66%	66%
Professional development	67%	77%	77%	81%	81%	83%
Program improvement	57%	68%	66%	66%	66%	70%
Articulation agreements	-	-	-	-	54%	60%
Respondents (n)	100	75	77	128	154	167

Table 13 disaggregates the information in Table 12 to compare center and project involvement in the various work categories. Project and center work activities changed differently across time. Because the program continued to expand across the 6 years, the numbers of projects and centers involved in each work category consistently increased annually. However, the relative proportions of projects and centers engaged in particular work activities varied substantially:

- The proportion of grantees engaged in materials development declined more substantially for centers than for projects.
- The proportion of projects engaged in professional development increased steadily, while it stayed relatively constant for centers.
- The proportion of projects engaged in program improvement increased substantially in 2001 and stayed near that higher level while the proportion for centers dropped by 17 percent in 2001 and stayed lower through 2005.

Table 13. Proportion of Projects and Centers Reporting Activity in Various Work Categories

	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Materials development						
Projects	73%	81%	84%	78%	72%	69%
Centers	90%	91%	89%	87%	57%	68%
Professional development						
Projects	64%	73%	74%	81%	86%	85%
Centers	90%	100%	100%	100%	81%	92%
Program improvement						
Projects	53%	67%	65%	64%	69%	72%
Centers	90%	73%	78%	93%	76%	76%
Articulation agreements						
Projects	-	-	-	-	58%	61%
Centers	-	-	-	-	52%	68%

	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Respondents (n)						
Projects	90	64	68	110	125	137
Centers	10	11	9	15	21	25

2.2 Workforce Needs Assessment

Although grantees are not specifically required to conduct workforce needs assessments, the ATE program solicitations do ask proposers to describe the needs that will be addressed. The annual survey addressed workforce needs assessments in two ways. In 2002 and 2003, grantees were asked what methods they employed when conducting workforce needs assessments. From those responses, we derived the total number of grantees that conducted a needs assessment in the 12 months prior to the annual survey. In 2004 and 2005, the survey directly asked respondents whether and how recently they had conducted needs assessments. As shown in Table 14, the large majority (>74 percent) reported having conducted a needs assessment. But, for the majority of grantees, those analyses were not current (i.e., done in the past year).

Table 14. Proportion of Grantees Reporting Workforce Needs Assessments

	2002	**2003**	**2004**	**2005**
Never	-	-	26%	22%
More than 12 months ago	-	-	46%	35%
In the last 12 months	43%	35%	28%	42%
Respondents (n)	77	128	151	164

2.3 Advisory Committees

NSF encourages grantees to form and use advisory committees to help guide their work and mandates that every large project and center will form a national visiting committee (NVC). An NVC is a national advisory committee that is distinctive in two ways: (1) members are chosen with the advice and consent of NSF and (2) it reports directly to NSF rather than just to the grantee. Table 15 shows that most grantees (75 percent or more in every year surveyed) used advisory committees and that local and national committees were more frequently used than regional ones. Although the survey did not specifically differentiate an NVC from a national committee, we infer that many of the national committees reported were in fact NVCs.

Table 15. Proportion of Grantees Reporting Use of Various Types of Advisory Committees

	2002	**2003**	**2004**	**2005**
National	-	44%	38%	40%
Regional	58%	22%	19%	26%
Local	53%	43%	42%	45%
Other	16%	9%	7%	10%
At least one type	90%	77%	79%	84%
Respondents (n)	76	126	151	164

2.4 Evaluation

ATE guidelines clearly mandate grant-level evaluations. Table 16 confirms that grantees are, overall, meeting this expectation. From 2000 to 2005, the large majority (more than 80 percent) of respondents engaged evaluators—usually external ones—for their grants.

Table 16. Proportion of Grantees Reporting Use of Various Types of Evaluators

	2000	2001	2002	2003	2004	2005
External evaluator	61%	68%	70%	63%	70%	66%
Internal evaluator	2%	4%	4%	9%	7%	6%
Both	20%	16%	20%	18%	11%	12%
At least one type	83%	88%	94%	89%	88%	84%
Respondents (n)	84	75	77	128	151	164

As shown in Table 17, a high proportion of respondents "agree" or "strongly agree" that their grant-level evaluations were useful and provided data-based evidence of the quality of their work.

Table 17. Proportion of Grantees Reporting Their Evaluations Were Useful and Provided Data-Based Evidence of Quality

	2002	2003	2004	2005
Useful	71%	72%	76%	76%
Provide data-based evidence	-	31%	75%	74%
Respondents (n)	76	127	161	164

2.5 Monitoring

NSF holds grantees accountable primarily through annual FastLane reports and, for large grants, the use of national visiting committees. In addition, ATE program officers monitor and assist grantees, interacting with them through a variety of mechanisms. These NSF interactions are intended to facilitate grant work and collaborations with other ATE grantees. Table 18 shows the proportion of grantees that reported interacting with NSF through various means.

Table 18. Proportion of Grantees Reporting Interaction with NSF Through Various Means

	2000	2001	2002	2003	2004	2005
Site visits by NSF	32%	36%	38%	34%	19%	20%
Site visits to NSF	56%	53%	50%	43%	28%	34%
Telephone call	81%	81%	83%	82%	65%	65%
E-mail	96%	95%	96%	95%	91%	87%
PI conference	76%	93%	80%	83%	91%	83%

	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Written feedback	76%	76%	68%	79%	38%	31%
Recommendations	-	-	-	-	34%	33%
Respondents (n)	100	75	76	127	151	164

As shown in this table, with the exception of the PI conference, use of all modes of interaction has declined since 2000. Grantee reports of receiving written feedback dropped sharply from 79 percent in 2003 to 31 percent in 2005. The use of e-mail has remained the most stable, fluctuating between 96 and 87 percent across years.

To ascertain their perceptions of NSF, grantees were asked to indicate their level of agreement or disagreement with the following statements: (1) NSF is responsive, (2) NSF evaluative actions help our grant, (3) NSF facilitates collaboration, and (4) NSF understands the work of our grant. As can be seen in Table 19, the proportion of respondents who "agree" or "strongly agree" with these statements is high. Ratings for "NSF is responsive" and "NSF understands the work of our grant" tended to increase across years. Ratings for "NSF's evaluative actions help our grant" and "NSF facilitates collaboration" do not have clear linear trends.

Table 19. Proportion of Grantees Reporting Agreement or Strong Agreement With Statements About NSF

	2000	**2001**	**2002**	**2003**	**2004**	**2005**
NSF is responsive	84%	97%	99%	99%	93%	94%
NSF evaluative actions help our grant	65%	85%	86%	93%	66%	62%
NSF facilitates collaboration	73%	92%	84%	95%	83%	80%
NSF understands the work of our grant	68%	85%	67%	87%	85%	87%
Respondents (n)	100	75	76	127	151	164

3.0 Collaboration

The ATE program encourages grantees to develop collaborative arrangements to promote improvement in technological education. This expectation is strongly embedded in the language of the NSF solicitation for ATE proposals. Consistent with program expectations, the annual survey asked four primary questions about grantees' collaborative activities:

- What is the extent and nature of collaboration with other ATE grantees?
- What is the extent and nature of collaboration with other non-ATE institutions?
- What is the extent of support provided through these collaborations?
- What type of collaborator is judged most effective by ATE grantees?

Across all survey years, "collaboration" was defined as "an *ongoing* relationship with another institution, business, or group that provides money and/or other support to your project, center,

or partnership. Collaborators may include local businesses; other educational institutions; public agencies; industry groups; other ATE projects, centers, and partnerships; and your host institution." Across years, between 90 and 98 percent of grantees reported collaborating with other entities in carrying out their ATE work.

3.1 Collaboration With Other ATE Grantees

As shown in Table 20, 47 percent of the respondents reported collaborations with other ATE grantees in 2005—a decline of 35 percent since 2002. On average, each project indicated 2 to 3 such collaborative efforts

Table 20. Proportion of Grantees Reporting Collaborations With Other ATE Grantees[a]

		2002	**2003**	**2004**	**2005**
Other ATE grantees	%	82%	71%	40%	47%
Total number of collaborations		-	-	207	176
M		-	-	3	2
Median		-	-	2	2
SD		-	-	5	2
Respondents	n	68	111	151	164

[a] The 2002 and 2003 annual surveys asked grantees to identify the purposes of their collaborations—the responses were then used to derive the numbers reporting collaborations. In 2004 and 2005, respondents were asked directly to indicate the number of collaborations.

3.2 Collaboration With Non-ATE Institutions

Table 21 shows that consistently large proportions of grantees reported collaborative efforts with non-ATE institutions. Eighty to 90 percent reported collaborations with business and industry and other educational institutions. Much smaller proportions collaborated with public agencies and other types of organizations.

The average grantee reported approximately a dozen or more collaborations with other educational institutions and even more with business and industry. Reported numbers of collaborations per project indicate that individual grantee's collaborations with business and industry increased slightly and those with other educational institutions declined. (There is wide variance in the numbers of collaborations reported, which is indicative of very large numbers of collaborations reported by a few grantees. This makes the averages less reliable as indicators.)

Table 21. Proportion of Grantees Reporting Collaborations With Non-ATE Institutions

		2000	2001	2002	2003	2004	2005
Business and industry	%	81%	91%	81%	81%	75%	81%
	Total collaborations	804	693	956	883	2,196	2,335
	M	15	13	17	10	19	18
	Median	6	10	10	5	8	6
	SD	19	14	29	17	54	54
Host institution	%	-	-	-	-	80%	86%
	Total collaborations	-	-	-	-	507	456
	M	-	-	-	-	4	3
	Median	-	-	-	-	1.5	1
	SD	-	-	-	-	9	4
Other education institutions	%	79%	95%	85%	84%	90%	85%
	Total collaborations	1,349	1,177	912	1,108	1,774	1,589
	M	25	22	16	12	13	11
	Median	13.5	10.5	8	5	5	5
	SD	42	29	18	27	25	21
Public agencies	%	53%	67%	62%	68%	38%	48%
	Total collaborations	208	140	128	227	236	316
	M	6	4	3	3	4	4
	Median	3	2	2	1	2	2
	SD	7	5	3	6	5	5
Other organizations	%	15%	16%	38%	47%	34%	36%
	Total collaborations	22	39	80	241	218	262
	M	2	4	3	5	4	4
	Median	2	2	2	1	2	2
	SD	1	8	3	15	7	8
Respondents	n	68	57	68	111	151	164

3.3 External Support

ATE grantees consistently used NSF support as a means to leverage additional funding and in-kind support from collaborating groups. Until 2005, cost sharing was required of grantees—proposers were reminded annually that cost sharing was considered an eligibility criterion and that any proposal not meeting that criterion could be returned without review. Because the annual surveys were completed only by grantees that had been funded for at least a year, all reporting grants were funded when the NSF cost-sharing criterion was in effect.

Each year, the survey asked grantees to indicate the amount of monetary and in-kind support received. On average over the 6-year period, grantees reported receipt of approximately $250,000 per year of additional support for grant work (calculated by dividing the total amount

received by the total number of annual survey respondents). Table 22 reports the amount of monetary and in-kind support received annually by ATE grantees.

Table 22. Grantees' Reports of Total Monetary and In-Kind Support ($1,000s)

		2000	**2001**	**2002**	**2003**	**2004**	**2005**
Monetary support	Total	$13,694	$12,205	$5,307	$10,690	$11,453	$18,221
	M	$201	$214	$78	$96	$154	$134
	Median	$24	$56	$17	$1	$50	$5
	SD	$678	$492	$127	$338	$472	$698
In-kind support	Total	$16,287	$24,017	$5,393	$10,092	$13,292	$15,965
	M	$240	$421	$79	$91	$121	$110
	Median	$58	$92	$16	$20	$30	$12
	SD	$742	$1,241	$154	$281	$483	$508
Total support	Total	$29,981	$36,222	$10,700	$20,782	$24,745	$34,186
	M	$441	$635	$157	$187	$210	$222
	Median	$125	$205	$67	$50	$75	$29
	SD	$1,026	$1,589	$231	$568	$838	$966
Respondents	n	68	57	68	111	151	164

Several trends are evident in these data. First, monetary, in-kind, and total support decreased dramatically from 2001 to 2002, but then grew through 2005. Second, there was a relative balance between monetary and in-kind support received during the survey period (i.e., one type was not consistently larger than the other). Third, the mean and standard deviation values confirm that most reporting grantees received relatively little support while a few received large amounts of support from their collaborators.

In 2004 and 2005, the survey also asked grantees to report the number and type of collaborators that provided support. Table 23, which presents these data, highlights two additional points. First, roughly twice as many collaborators (more in some cases) provided in-kind support as compared to monetary support. Second, most collaborators came from educational institutions and business and industry.

Table 23. Proportion of Grantees Reporting Monetary and In-Kind Support From Various Sources

		2004		2005	
		Monetary	**In-Kind**	**Monetary**	**In-Kind**
Business and industry	%	21%	59%	21%	61%
	Total sources	177	1,285	180	1,327
	M	6	14	5	13
	Median	3.5	5	2	5
	SD	5	31	10	29
Host institution	%	34%	56%	40%	65%
	Total sources	85	329	110	263
	M	2	4	2	3
	Median	1	1	1	1
	SD	2	10	2	3
Other education institutions	%	19%	54%	15%	60%
	Total sources	267	2,050	107	952
	M	9	25	4	10
	Median	2	5.5	1	4
	SD	23	113	7	22
Public agencies	%	10%	25%	15%	29%
	Total sources	32	157	51	212
	M	2	4	2	4
	Median	1	2	1	2
	SD	2	5	2	6
Other ATE grantees	%	9%	21%	12%	25%
	Total sources	23	95	27	80
	M	2	3	1	2
	Median	1	2	1	2
	SD	1	4	1	1
Other organizations	%	7%	17%	7%	21%
	Total sources	20	135	31	167
	M	2	5	3	5
	Median	1	2	1	2
	SD	1	10	4	9
Respondents	n	151		164	

3.4 Most Effective Collaborators

Grantees were asked to identify their most effective type of collaborator. Table 24 shows that other education institutions were most frequently reported to be the most effective type of collaborator for ATE grantees, followed by business and industry.

Table 24. Grantees' Reports of Most Effective Collaborators

	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Business and industry	37%	47%	41%	38%	31%	29%
Host institution	-	-	-	-	22%	26%
Other education institution	47%	35%	44%	49%	32%	30%
Public agencies	6%	5%	12%	11%	3%	4%
Other ATE grantees	-	-	-	-	4%	6%
Other organizations	10%	12%	3%	3%	5%	4%
Respondents (n)	68	57	68	111	151	164

4.0 Materials Development

ATE program guidelines stress that materials development work should be limited to preparing high quality materials for national dissemination. However, anecdotal feedback suggests that many grantees developed materials for use in the context of their own professional development and curriculum improvement efforts, not for wide distribution.

Three primary indicators are reported for materials development. The first addresses productivity—the number and type of materials produced. The second addresses development practices—the extent to which grantees engaged in development and quality assurance practices known to improve the quality of developed materials. The third addresses the dissemination and use of developed materials.

Three categories of materials were addressed in the annual survey: courses, modules, and "other" types of materials. A course was defined as a series of lessons that leads to a specified number of credit hours at the college level. Modules were regarded as components of courses that could be appropriate for inclusion in a number of different courses. In this sense, modules could be considered the building blocks for courses and programs. "Other" was a catch-all category and included materials for Web-based training, marketing, or recruitment and other supporting materials keyed to any number of program activities. We know, however, that survey respondents interpreted these categories differently, so these results should be used with caution—at best the values provide a general barometer of grantee activity.

4.1 Productivity

Table 25 indicates the proportion of grantees engaged in materials development first increased and then decreased over the 6-year period. Results for materials developed followed similar patterns, with more products produced earlier and fewer most recently. In sum, more than 5,000 material items were produced across the 6 years, including more than 1,600 courses, 2,500

modules, and 1,000 other types of materials. This table also shows that materials development dropped substantially in 2004 and even more in 2005.

Table 25. Grantees' Reports of the Number of Completed Courses, Modules, and Other Materials

		2000	**2001**	**2002**	**2003**	**2004**	**2005**	**Total**
Courses	Total	374	295	314	334	198	134	1,649
	M	10	9	12	8	6	4	
	Median	4	4	6	3	5	3	
	SD	16	12	13	13	6	4	
Modules	Total	477	495	588	303	392	253	2,508
	M	12	19	21	8	10	7	
	Median	5	10	10	5.5	4	4	
	SD	25	28	28	10	19	9	
Other types	Total	204	58	135	456	132	75	1,060
	M	16	12	11	24	8	6	
	Median	4	4	2.5	2	4	2	
	SD	30	16	28	88	10	11	
Total materials		1,055	848	1,037	1,093	722	462	5,217

4.2 Development Practices

Materials development practices are grouped into three categories. The first includes activities to assure that the materials are properly focused on workforce needs and will comply with industry standards. The second includes data-gathering strategies for checking the appropriateness and quality of the materials during development and upon completion. The third addresses ways in which student assessment information was used to verify effectiveness of the materials.

Table 26 indicates the proportion of grantees reporting that they engaged in each of these practices "most of the time" or "all the time" when developing materials. The table shows that in most years, three-fourths or more of grantees reported verifying alignment with workforce needs and using applicable student and industry guidelines when developing materials. In addition, pilot tests and internal field tests of materials were conducted by most grantees. However, external field tests were routinely conducted by fewer than half. This table also shows that when student assessment was used to assess the quality of materials, grantees were more likely to compare the performance of students taught using their materials against industry standards rather than against the performance of students taught with other materials. In fact, the proportion of grantees reporting comparison of student achievement against competitor curricula was not high in any year; it was highest (44 percent) in 2000 but declined to 29 percent by 2005. Additionally, there was a drop off in the use of both types of student assessment for checking and assuring material quality in the last two years surveyed.

Table 26. Proportion of Grantees Reporting Various Materials Development Practices

	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Verify alignment with workforce needs	76%	77%	82%	89%	74%	72%
Use applicable student and industry standards and guidelines	77%	79%	79%	94%	74%	80%
Pilot test materials	76%	81%	82%	73%	73%	78%
Field test internally	65%	79%	92%	80%	75%	78%
Field test externally	47%	39%	49%	47%	40%	45%
Assess student success in comparison with industry standards	60%	65%	43%	68%	30%	31%
Assess student success in comparison with non-project students	44%	39%	39%	38%	24%	29%
Respondents (n)	75	62	65	99	102	111

4.3 Dissemination

Table 27 indicates grantees' reports of the number of materials (courses, modules, and other types) that were used locally, used elsewhere, and/or were published commercially. The numbers indicate that most use of developed courses occurred at the local level—in total, more than three times as many courses were used locally as those that were used elsewhere or published commercially. Module use was more widespread, with slightly more being used elsewhere than locally. Almost twice as many "other" types of materials were used elsewhere as locally. More than 500 modules and other materials were reported to have been published commercially, compared with 135 courses.

Table 27. Grantees' Reports of the Number of Materials Commercially Published and/or Used Locally and Elsewhere

	2000	2001	2002	2003	2004	2005	Total
Course use							
Local	283	309	299	329	305	246	1,771
Elsewhere	123	107	103	45	1,554[a]	77	489
Published commercially	48	50	27	0	1	9	135
Module use							
Local	442	1263	472	292	496	243	3,208
Elsewhere	268	419	641	670	765	579	3,342
Published commercially	46	171	1	8	275	62	563
Other use							
Local	179	58	138	460	566	53	1,454
Elsewhere	136	22	786	16	1,340[a]	131	2,431
Published commercially	0	3	501	4	3	5	516

[a]These numbers are such anomalies that we doubt their accuracy; they are not reflected in the totals

5.0 Professional Development

ATE program guidelines indicate program support for efforts to provide secondary school teachers and college faculty with opportunities for continued professional growth in areas that directly impact advanced technological education. Information about such professional development activities of grantees was sought in all 6 years of the survey. Findings show an increase in professional development activity: In 2000, two-thirds of grantees reported activity in this area; from 2001 to 2005, about 80 percent of grantees did so (see Table 11). The annual survey addressed three aspects of grantees' professional development activities: (1) number and type of programs offered, (2) participants, and (3) impact.

5.1 Number and Type of Professional Development Activities

ATE grantees developed and delivered a variety of different types of professional development activities. These ranged from workshops to long-term programs and internships. Across all years, the overall number various professional development activities increased substantially, as shown in Table 28. In 2005, a total of 2,195 professional development activities were offered by ATE grantees. Where comparable data were available, the number of event-based professional development activities was substantially larger than for events-with-follow-up activities, internships, self-study, and other longer-term activities. Additionally, the number of grantees engaged in event-based activities tended to be at least twice that for other activities.

Table 28. Grantees' Reports of the Number and Type of Professional Development Activities

		2000	2001	2002	2003	2004	2005
Events	n	128	125	112	166	969	890
	M	4	4	3	3	9	8
	Median	3	2	2	1	2	4
	SD	3	4	4	4	23	16
Events with follow-up	n	-	-	-	-	155	359
	M	-	-	-	-	3	6
	Median	-	-	-	-	1	2
	SD	-	-	-	-	3	11
Long-term programs	n	-	-	-	-	280	289
	M	-	-	-	-	7	6
	Median	-	-	-	-	2	2
	SD	-	-	-	-	20	16
Internships	n	127	43	43	36	91	261
	M	6	2	2	1	5	10
	Median	2	2	0	0	2.5	2
	SD	12	3	5	2	6	18
Self-study programs	n	-	-	-	-	1,199	396
	M	-	-	-	-	57	23
	Median	-	-	-	-	3	2
	SD	-	-	-	-	217[a]	72[a]
Respondents	n	67	58	59	104	125	139

[a] These large standard deviations indicate that a few awardees reported offering a very high number of self-student programs, while most offered much fewer.

5.2 Participation

In addition to increases in the number of professional development activities, professional development also grew in terms of participation rates. Overall, respondents reported about 81,000 professional development participants. As Table 29 shows, participation numbers increased across years for all three types of institutions. The number of annual participants more than doubled at the associate degree level, increased more than sixfold at the secondary school level, and more than fivefold at the baccalaureate level.

As these substantial increases suggest, the complexion of professional development changed across the 6 years. In 2000, the large majority of professional development participants were engaged at the associate degree level, exceeding the combined number of secondary school and baccalaureate participants. By 2005, associate degree faculty comprised just a third of the total participants, with secondary school faculty the primary audience for these activities.

Table 29. Grantees' Reports of the Number of Professional Development Participants at Different Education Levels

		2000	**2001**	**2002**	**2003**	**2004**	**2005**	**Total**
Secondary	n	2,351	2,898	1,839	3,313	9,316	15,648	35,365
	M	49	60	35	38	102	163	
	SD	82	147	57	69	303	583	
Associate	n	4,322	3,853	3,095	5,975	9,608	9,649	36,502
	M	79	71	57	59	104	93	
	SD	211	188	80	109	274	122	
Baccalaureate	n	519	261	832	1,063	3,692	2,765	9,132
	M	16	6	18	13	50	33	
	SD	18	10	48	25	168	48	
Total Participants	n	7,192	7,012	5,766	10,351	22,616	28,062	80,999
Respondents	n	67	58	59	104	125	139	

5.3 Impact

As with materials development, grantees were encouraged to evaluate their professional development efforts. The annual survey addressed this issue on three levels: participant satisfaction, classroom implementation, and impact on student achievement. Because of the expected variation in how grantees conducted these types of evaluations, we did not ask for direct evidence on these dimensions. Rather, we asked grantees to report the percentage of participants that indicated satisfaction or intent to use, implementation, and increased student achievement. These results, shown in Table 30, are reported for each type of professional development activity.

Table 30. Grantees' Reports of the Proportion of Professional Development Participants Reporting Various Outcomes

		2000	2001	2002	2003	2004	2005
Events							
satisfied or intend to use	M	87%	90%	76%	76%	87%	91%
	SD	27%	22%	35%	35%	17%	12%
number of reporting grantees		36	27	23	38	101	107
tried or implemented	M	71%	70%	47%	44%	65%	60%
	SD	34%	33%	37%	40%	33%	32%
number of reporting grantees		24	19	16	23	63	69
student achievement	M	-	-	-	-	63%	67%
increased	SD	-	-	-	-	31%	26%
number of reporting grantees		-	-	-	-	40	31
Events with follow-up							
satisfied or intend to use	M	-	-	-	-	86%	89%
	SD	-	-	-	-	23%	15%
number of reporting grantees		-	-	-	-	49	52
tried or implemented	M	-	-	-	-	72%	69%
	SD	-	-	-	-	34%	26%
number of reporting grantees		-	-	-	-	37	39
student achievement	M	-	-	-	-	67%	64%
increased	SD	-	-	-	-	29%	27%
number of reporting grantees		-	-	-	-	23	22
Long-term programs							
satisfied or intend to use	M	-	-	-	-	87%	91%
	SD	-	-	-	-	24%	18%
number of reporting grantees		-	-	-	-	37	38
tried or implemented	M	-	-	-	-	77%	75%
	SD	-	-	-	-	30%	33%
number of reporting grantees		-	-	-	-	30	25
student achievement	M	-	-	-	-	73%	81%
increased	SD	-	-	-	-	22%	21%
number of reporting grantees		-	-	-	-	18	16
Internships							
satisfied or intend to use	M	74%	52%	68%	66%	88%	97%
	SD	43%	51%	47%	48%	24%	5%
number of reporting grantees		17	10	12	15	19	22
tried or implemented	M	60%	35%	51%	45%	81%	68%
	SD	47%	48%	42%	42%	31%	43%
number of reporting grantees		13	8	11	14	11	11
student achievement	M	-	-	-	-	88%	85%
increased	SD	-	-	-	-	13%	26%

		2000	2001	2002	2003	2004	2005
number of reporting grantees		-	-	-	-	5	9
Self-study programs							
satisfied or intend to use	M	-	-	-	-	76%	86%
	SD	-	-	-	-	39%	20%
number of reporting grantees		-	-	-	-	15	15
tried or implemented	M	-	-	-	-	76%	68%
	SD	-	-	-	-	34%	24%
	n						
number of reporting grantees		-	-	-	-	10	13
student achievement	M	-	-	-	-	80%	56%
increased	SD	-	-	-	-	25%	25%
	n						
number of reporting grantees		-	-	-	-	6	13
Respondents	n	67	58	59	104	125	139

Two findings are evident in these data. First, grantees reported that the large majority of participants were satisfied with the professional development activities they attended. Second, large proportions of grantees also reported that most participants indicated that they tried or implemented knowledge and skills gained from the professional development and that student achievement had increased as a result.

This second finding, however, should be treated with caution. As shown in the table, a relatively low number of grantees responded to items asking about participant reports of implementation and student achievement. For example, in 2005, 107 grantees offering event-based professional development activities reported that, on average, 91 percent of their participants were satisfied. Far fewer (69 grantees) reported participant feedback on implementation and fewer still (31 grantees) reported participant feedback on student achievement. Not as many grantees offered long-term professional development programs as other types, but their results were more favorable. For example for long-term programs in 2005, 91 percent of 38 respondents indicated participant satisfaction and 81 percent of 16 indicated that professional development efforts resulted in student achievement increases.

6.0 Program Improvement

ATE grantees engage in program improvement activities intended to directly impact students, including developing or improving courses and programs for current and prospective technicians. The annual survey addressed four primary indicators of activity in this area: (1) number of programs developed, (2) number of locations where these programs were offered, (3) number of courses developed, and (4) number of students attending at least one course. Overall results are reported, as well as by the targeted education levels.

6.1 Productivity

From 2000 to 2005, ATE grantees reported that they created or revised more than 3,000 programs and 17,000 courses and engaged an average of more than 60,000 students at more than 800 locations per year. Across that span of time, emphases changed in several ways. As shown in Table 31, the number of developed or changed programs increased substantially, increasing by more than 300 to the 2005 level of 690. In contrast, the number of developed or changed courses dropped substantially in the 2 most recent survey years. In 2005, course changes numbered just under 2,000—less than half the number reported 5 years earlier. The number of students reached varied substantially by year and shows no clear trend. The number of locations at which these courses and programs were delivered more than doubled across the 6 years to more than 1,100 places in 2005. (A caveat on these findings is that relatively few grantees disproportionately impacted the annual total and average values because of the high numbers they reported for program, courses, students, and/or locations [note the standard deviation values].)

Table 31. Grantees' Reports of the Number of Programs and Courses Developed or Changed, Locations, and Students

		2000	2001	2002	2003	2004	2005	Total
Programs	Total	371	508	462	523	557	690	3,111
	M	5	7	7	4	7	7	
	Median	3	2	2	2	2	2	
	SD	8	22	14	11	13	19	
Locations	Total	479	954	489	824	1,050	1,143	4,939
	M	6	14	7	7	15	14	
	Median	3	4	4	4	6	4	
	SD	13	46	12	14	24	26	
Courses	Total	4,567	3,713	3,108	4,381	1,627	1,973	19,369
	M	58	58	44	37	21	21	
	Median	24	17	18	12	9	8	
	SD	212	144	123	109	36	34	
Students	Total	50,617	121,666	32,775	68,450	47,136	65,052	385,696
	M	675	1,763	468	585	589	723	
	Median	162.5	197	150	135	134.5	91	
	SD	2,491	9,037	1,257	1,993	1,370	1,676	
Respondents	n	57	51	51	84	102	117	

As indicated in Table 32, when viewed by education level, the greatest program improvement productivity occurred consistently at the associate degree level, which is consistent with the program's emphasis on associate level education. Associate degree institutions played a major role both in terms of numbers of grants and measures of their productivity.

- Associate degree grantees engaged in developing or changing programs in numbers 2 to 3 times that of secondary schools and 6 to 7 times greater than baccalaureate institutions and on-the-job programs.
- Associate level programs (2,066) greatly outnumbered secondary (787) and baccalaureate programs (162). Approximately 100 on-the-job programs were developed in the 2 years we captured that information.
- Associate level courses (16,842) outnumbered secondary (1,534) and baccalaureate (848) courses by factors of 11 and 20, respectively. The number of associate level courses produced or revised in 2005 nearly equaled the number produced across all 6 years at the secondary-level courses and doubled the total for the baccalaureate level.
- Students reached at associate degree programs (324,391) outnumbered secondary (48,966) and baccalaureate (6,827) programs by factors of 7 and 48, respectively.

Table 32. Grantees' Reports of the Number of Programs, Locations, Courses, and Students by Education Level

		2000	**2001**	**2002**	**2003**	**2004**	**2005**	**Total**
Programs								
Secondary	Total	90	47	71	153	143	283	787
	M	4	3	4	6	5	9	
	SD	3	3	9	14	15	22	
Associate	Total	258	451	350	336	324	347	2,066
	M	5	10	7	4	4	4	
	SD	10	26	16	10	9	10	
Baccalaureate	Total	23	10	41	34	31	23	162
	M	3	2	7	2	2	2	
	SD	4	2	14	5	1	1	
On-the-job	Total	-	-	-	-	59	37	
	M	-	-	-	-	4	3	
	SD	-	-	-	-	4	3	
Locations								
Secondary	Total	172	447	135	278	450	288	1,770
	M	8	26	8	11	17	11	
	SD	15	84	8	14	28	19	
Associate	Total	291	496	345	532	457	521	2,642
	M	6	11	7	7	7	7	
	SD	13	24	13	14	10	13	
Baccalaureate	Total	16	11	9	14	52	33	135
	M	2	2	2	1	3	2	
	SD	2	2	2	0	3	2	
On-the-job	Total	-	-	-	-	91	301	
	M	-	-	-	-	7	27	
	SD	-	-	-	-	6	46	

		2000	**2001**	**2002**	**2003**	**2004**	**2005**	**Total**
Courses								
Secondary	Total	552	129	121	279	179	274	1,534
	M	25	10	8	11	7	11	
	SD	72	9	13	15	20	27	
Associate	Total	3,858	3,467	2,864	3,839	1,333	1,481	16,842
	M	77	75	60	51	19	17	
	SD	262	167	146	132	34	28	
Baccalaureate	Total	157	117	123	263	94	94	848
	M	22	23	21	16	7	8	
	SD	32	26	22	40	11	7	
On-the-job	Total	-	-	-	-	21	124	
	M	-	-	-	-	2	12	
	SD	-	-	-	-	2	15	
Students								
Secondary	Total	4,890	11,935	2,201	4,991	10,243	14,706	48,966
	M	245	702	138	200	330	588	
	SD	394	1,256	188	336	692	1,044	
Associate	Total	43,915	108,296	29,986	62,097	32,691	47,406	324,391
	M	915	2304	625	817	448	564	
	SD	3,086	10,919	1,492	2,439	1,196	1,444	
Baccalaureate	Total	1,812	1,435	588	1,362	1,145	485	6,827
	M	259	287	98	85	67	35	
	SD	401	236	82	123	118	39	
On-the-job	Total	-	-	-	-	3,057	2,455	
	M	-	-	-	-	255	205	
	SD	-	-	-	-	786	565	
Respondents	n	57	51	51	84	102	117	

7.0 Articulation Agreements

Development of instructional pathways from secondary schools to 2-year colleges to baccalaureate programs has always been an important objective of the ATE program. In 2000, the program created a special track for articulation agreements that highlighted the program's interest in this area. The annual survey was modified in 2004 to track this special type of emphasis.

The findings from just 2 years (2004 and 2005) are not sufficient to show trends, but they do provide indications of the productivity and impact of articulation agreements. Additionally, because respondents were instructed to complete this survey section only if articulation agreements played a *substantial* role for them, there may have been some grantees that established articulation agreements, but did not provide responses for this section. As a result, we

believe that the totals shown underestimate the productivity and impact of articulation agreements.

7.1 Productivity

ATE supports three types of articulation agreements: (1) agreements between secondary and associate degree institutions for technician education, (2) agreements between associate and baccalaureate institutions for technological degrees, and (3) agreements between associate and baccalaureate institutions for teacher preparation. These agreements guarantee the right of a student to matriculate from one institution to the next upon graduation and meeting other specified requirements. These agreements necessarily require approvals beyond the bounds of the project and, as such, fit what is commonly called institutionalization of project outcomes.

The 2004 and 2005 surveys addressed two aspects of productivity: the number of articulation agreements made at the various institutional levels and number of institutions participating in these agreements. Table 33 shows that the typical project developed multiple articulation agreements: In 2005, there was an average of 20 agreements per grantee for transitions from high school programs to 2-year colleges, 6 per grantee for transitions from 2- to 4-year colleges, and 4 per project for transitions to teacher preparation programs at 4-year colleges. In total, more than 2,000 agreements were reported in 2004 and 2005 to address the three transition points. As the per project averages indicate, most agreements (1,479) affected the high school to 2-year college point, and the fewest (87) focused on 2-year colleges as feeder points for teacher preparation in technical education.

Table 33. Grantees' Reports of the Number of Articulation Agreements

		2004	**2005**	**Total**
High school to 2-year college	Total	813	666	1,479
	M	28	20	
	Median	4	4	
	SD	78	68	
2-year college to 4-year college	Total	230	254	484
	M	6	6	
	Median	2	2	
	SD	11	11	
Teacher preparation: 2-year college to 4-year college	Total	34	53	87
	M	2	4	
	Median	1	1	
	SD	3	5	
Total agreements	n	1,077	973	2,050
Respondents	n	83	100	

Table 34 identifies the number of institutions involved in various articulation agreements.

Table 34. Grantees' Reports of the Number of Institutions Involved in Articulation Agreements

		2004	**2005**	**Total**
High school to 2-year college	Total	728	909	1,637
	M	25	26	
	Median	12	8	
	SD	41	48	
2-year college to 4-year college	Total	257	424	681
	M	6	9	
	Median	3	3.5	
	SD	8	16	
Teacher preparation: 2-year college to 4-year college	Total	139	175	314
	M	11	12	
	Median	3	3	
	SD	14	16	
Total institutions	n			2,632
Respondents	n	83	100	

Analyzing Tables 33 and 34 in conjunction suggests that the ATE grantees typically engaged one to two other institutions per agreement for technician articulations. For example, in 2004, 728 institutions were involved in 813 agreements for high school to 2-year college transitions; in 2005, 424 institutions were involved in 254 agreements for 2-year to 4-year college transitions. These 1:1 to 1:1.5 correspondences suggests that each agreement would only serve students matriculating to one or two specific second institutions. However, for teacher preparation, for every one agreement, there were three to four different institutions involved. In 2005, there were 175 institutions involved in 53 agreements for teacher preparation; in 2004, the numbers were 139 and 34, respectively. In such situations, a student completing the teacher preparation portion at a 2-year college could choose among multiple baccalaureate institutions to complete the teaching program.

7.2 Impact

Approximately 4,500 students were served by these articulation agreements in the 2 years surveyed, as shown in Table 35. Most (2,300) moved from high school to associate degree institutions. Again, the fewest (613) moved from 2-year to 4-year colleges in teacher preparation programs.

Though the raw numbers imply the technician articulations yield the greatest impact, the long term effects likely are opposite of appearances. The high school to 2-year college and 2-year to 4-year teacher preparation articulations really address separate types of long term impact. Each person who successfully completes a technician program at a higher education institution and then enters the workforce will individually improve the technician workforce. That is, this person impacts the workforce by a factor of 1. Students who successfully complete the teacher preparation strand, however, do not enter the technical workforce, but are expected to become

teachers in technician programs. Just one new teacher with improved technical education knowledge and abilities is likely to touch an additional 30 or more students *per year*. Such estimates suggest that articulation agreements leading directly to technician workforce jobs, though substantial in number, ultimately will make a smaller impact than the smaller numbers articulating toward teaching in technician programs.

Table 35. Grantees' Reports of the Number of Students Who Articulated in the Past 12 Months

		2004	**2005**	**Total**
High school to 2-year college	Total	1,136	1,164	2,300
	M	57	65	
	Median	15.5	31.5	
	SD	107	101	
2-year college to 4-year college	Total	634	908	1,542
	M	22	48	
	Median	10	8	
	SD	40	105	
Teacher preparation: 2-year college to 4-year college	Total	351	262	613
	M	44	26	
	Median	21.5	13	
	SD	50	28	
Total students	n	2,121	2,334	4,455
Respondents	n	83	100	

8.0 Student and Workforce Impact

Because the ATE goals are to increase the number and quality of technicians in the United States, each annual survey addressed three demographic and outcome points of interest:

- Gender and racial/ethnic composition of program participants
- Student outcomes—did they complete or leave the program
- Whether students who completed the program took technician positions or continued their STEM education

Two aspects of the program improvement part of the survey cause us to encourage caution in interpreting these findings. First, the context for answering many of these questions changed in 2004. Prior to 2004, grantees were asked to report student numbers for *one* specific ATE technician or STEM program. From 2004 on, grantees were asked to report student numbers for *all* their ATE programs combined. Second, for a variety of reasons, methods used by survey respondents for collecting data regarding students' gender and race/ethnicity and follow-up of graduates tend to be unreliable and unsystematic. For example, a project staff member may simply visually scan a room to determine its racial/ethnic makeup. Determination of how many

will take jobs in technician fields after program completion may be based on graduation interviews rather than on post-graduation employment surveys.

8.1 Demographics

NSF seeks to increase the participation of women, underrepresented minorities, and persons with disabilities through ATE program activities.

Overall, the female participation rate changed very little over the years, fluctuating between 30 and 37 percent, but with no clear trend, as shown in Table 36.

Table 36. Grantees' Reports of Female Participation Rates[a]

		2000	**2001**	**2002**	**2003**	**2004**	**2005**
Female	M	36%	30%	33%	31%	35%	35%
	SD	21%	24%	25%	25%	26%	23%
Respondents	n	57	51	51	84	102	117

[a] In 2004 and 2005, survey responses that had missing data for either male or female numbers were dropped from the gender calculation; in all, five grantees were dropped from the calculations.

Likewise, there were no substantial gains in the participation rates of minorities from 2000 to 2005. As Table 37 shows, the largest increases were for Hispanic/Latino participation, which increased about 5 percent, and for American Indian/Alaska Native participation, which increased the most—about 10 percent.

Table 37. Grantees' Reports of Racial and Ethnic Participation Rates [a]

		2000	**2001**	**2002**	**2003**	**2004**	**2005**
Hispanic/Latino	M	13%	13%	16%	12%	20%	18%
	SD	13%	20%	23%	21%	21%	21%
American Indian/Alaska Native	M	4%	8%	6%	7%	8%	15%
	SD	5%	24%	17%	20%	20%	29%
Asian	M	12%	7%	5%	5%	7%	7%
	SD	13%	9%	8%	9%	9%	8%
African American	M	17%	15%	17%	11%	25%	19%
	SD	13%	16%	20%	16%	23%	18%
Native Hawaiian	M	10%	1%	2%	0%	4%	9%
	SD	8%	2%	8%	1%	7%	9%
White	M	66%	55%	53%	56%	62%	60%
	SD	26%	32%	31%	33%	26%	25%

		2000	**2001**	**2002**	**2003**	**2004**	**2005**
Multiracial	M	-	-	-	-	11%	9%
	SD	-	-	-	-	15%	17%
Respondents	n	57	51	51	84	102	117

[a] Means and associated standard deviations reflect respondents' reports of the racial/ethnic composition of students enrolled in their courses/programs.

Additionally, participation by persons with disabilities declined overall, from 10 percent in 2000 to just 3 percent in 2005.

8.2 Outcomes

Here we looked at variables that addressed (a) enrollment in technician programs, (b) student persistence (i.e., completion or continuance) in those programs, (c) employment/education trends both for persons completing programs and those who left programs prior to completion. We viewed these variables from perspectives of three education levels: secondary schools, associate colleges, and baccalaureate colleges.

In addition to the caveats noted at the beginning of this section, we add the caution that sample sizes for both secondary school and baccalaureate levels tended to be small, making individual statistics less reliable. Moreover, although respondents were instructed to make sure that their reported numbers of students enrolled in the prior 12 months should equal the number who completed the program plus the number continuing plus the number who left during that same time period, the reported numbers do not conform to this guideline. Similarly, in some cases more students were reported to have gained employment or continued STEM education upon program completion than were reported to have completed the program. These conditions indicate the need to treat these results with considerable caution.

As shown in Table 38, the number of grantees reporting their engagement in secondary programs has remained relatively stable: 27 in 2000 and 25 in 2005. The proportion of grantees active at the associate level increased by about 50 percent across the years to 75 in 2005. The number of engaged in baccalaureate programs dropped from 19 in 2000 to 11 in 2005.

Student enrollment in ATE-supported programs greatly increased at the secondary school level, increasing about five-fold from 2000 to 2005. There were even larger increases in enrollments at the associate degree level—in 2005, it was more than 15 times the size of the enrollment in 2000. There was considerable fluctuation in enrollments at the baccalaureate level over the years. These trends are depicted in Table 38.

Program success in terms of retention of enrolled students has been high. At the associate level, it was reported that annually between 4 and 16 percent of students left programs prior to completion; at the baccalaureate level, between 0 and 8 percent left. (Comparable data are not available for the secondary level).

Findings showed that students who completed secondary and 2-year college programs were highly likely to continue a STEM or technician course of action. In most years, 90 percent or

more of students who completed programs at 2-year colleges were reported to either be employed as technicians or continuing their STEM education. Students who completed secondary school technician programs were much more likely to continue their STEM education than to become employed as technicians. Just the opposite was reported for most years at the associate level, where typically half to two-thirds of the students who completed 2-year programs were reported to have gained employment or continued employment as technicians.

Table 38. Grantees' Reports of Student Enrollments and Outcomes

		2000	**2001**	**2002**	**2003**	**2004**	**2005**
Secondary							
Enrolled	n	3,256	2,741	841	1,072	13,602	16,073
Completed	n	2,367	479	278	564	1,671	5,049
	%	73%	17%	33%	53%	12%	31%
Started/continued	n	1,465	93	118	120	35	506
employment	%	62%	19%	42%	21%	0%	10%
Continued STEM	n	345	262	209	271	624	2,545
education	%	15%	55%	75%	48%	37%	50%
Continuing	n	-	-	-	-	719	7,024
	%	-	-	-	-	5%	44%
Respondents	n	27	17	16	25	26	25
Associate							
Enrolled	N	3,134	6,468	7,267	20,452	38,011[a]	49,541[a]
Completed	n	1,489	1,992	974	2,499	7,023	7,206
	%	48%	31%	13%	12%	19%	15%
Started/continued	n	966	954	654	1,654	3,381	4,604
employment	%	65%	48%	67%	66%	48%	64%
Continued STEM	n	396	588	290	631	5,736	7,300
education	%	27%	30%	30%	25%	82%	101%[b]
Continuing	n	-	-	-	-	15,525	31,638
	%	-	-	-	-	41%	64%
Left	n	505	901	317	568	4,240	7,640
	%	16%	14%	4%	3%	11%	15%
Started/continued	n	444	425	157	179	1,527	1,417
employment	%	88%	47%	50%	32%	36%	19%
Continued STEM	n	169	82	38	80	424	233
Education	%	34%	9%	12%	14%	1%	3%
Respondents	n	53	47	48	77	60	75
Baccalaureate							
Enrolled	N	1,002	700	732	1,378	1,740[a]	573[a]
Completed	n	197	220	117	264	119	150
	%	20%	31%	16%	19%	7%	26%
Started/continued	n	58	58	175	100	9	50
employment	%	29%	26%	150%[b]	38%	8%	33%
Continued STEM	n	40	65	27	111	122	469
Education	%	20%	30%	23%	42%	103%[b]	312%[b]

		2000	2001	2002	2003	2004	2005
Continuing	n	-	-	-	-	319	256
	%	-	-	-	-	18%	45%
Left	n	28	58	43	38	6	4
	%	3%	8%	6%	3%	0%	1%
Started/continued	n	25	19	80	0	0	18
employment	%	89%	33%	186%[b]	0%	0%	3%
Continued STEM	n	20	0	51	21	0	2
Education	%	71%	0%	119%[b]	55%	0%	0%
Respondents	n	19	5	6	16	11	11

[a] The numbers of students completing, continuing, and leaving the program should equal the number reported to have been enrolled, but the reported numbers fall short of adding up to 100 percent.

[b] The numbers of students who were reported to be employed or continuing their education upon either program completion or leaving the program should equal the total "completed" or "left," but in these cases the number of students in one subcategory exceeded 100 percent of the total.

References

National Science Foundation. (2005). *Program solicitation* (NSF 05-530). Washington, DC: Author.

National Science Foundation. (2004). *Program solicitation* (NSF 04-541). Washington, DC: Author.

Appendix A:

Performance Indicators and Data Sources

Performance Indicators and Data Sources

Indicator	Data Source(s)	
	2000-2003	2004-2005
Grantee Characteristics (formerly *Project* Characteristics)		
Demographics	• Funding categories (project, center, articulation partnership) • Institution type (secondary school, 2-year college, 4-year college/university, association/society, other) • Award amounts (quartiles) • Age of grant (number of years between start date of current funding and survey date) • Technology emphasis	• Funding categories • Institution type • Award amounts • Age of grant
Stability	• Principal investigator ratings of project status compared to the previous 12 months (9 ratings on different topics)	N/A
Unintended outcomes	• Number of projects reporting unintended outcomes (positive and negative)	N/A
Barriers to success	• Open-ended responses detailing barriers to success	• Open-ended responses detailing organizational challenges
Sustainability	• Open-ended responses detailing plans for sustaining project operations after the end of ATE funding	• Open-ended responses detailing plans for sustaining project operations after the end of ATE funding
Organizational Practices		
Work categories	• Number of grantees engaged in four work categories	• Number of grantees engaged in four work categories
Workforce needs assessment	• Number of grantees conducting different forms of workforce needs assessment	• Number of grantees conducting workforce needs assessment in the past 12 months
Advisory committees	• Number of grantees *s* engaging different types of advisory committees	• Number of grantees engaging different types of advisory committees • Percentage of award spent for advisory committees
Evaluation	• Number of grantees using internal and/or external evaluators • Usefulness of evaluation information • Amount of evidence of quality provided by evaluation	• Number of grantees using internal and/or external evaluators • Usefulness of evaluation information • Amount of evidence of project quality provided by evaluation • Percentage of award spent for evaluation

Indicator	Data Source(s)	
	2000-2003	**2004-2005**
Monitoring	• Number of grantees reporting various NSF monitoring activities and frequency of that engagement • Grantees' perceptions of NSF related to participation in monitoring activities	• Number of grantees reporting various NSF monitoring activities and frequency of that engagement • Grantees' perceptions of NSF related to participation in monitoring activities
Collaboration		
Collaborations with other ATE grantees	• Purposes of collaborations with other ATE grantees	• Purposes of collaborations with other ATE grantees • Number of collaborations with other ATE grantees
Collaborations with non-ATE institutions	• Purposes of collaborations with non-ATE institutions • Number of collaborations with non-ATE institutions	• Purposes of collaborations with non-ATE institutions • Number of collaborations with non-ATE institutions
External support	• Number of grantees receiving monetary and/or in-kind support from different external sources • Total monetary and in-kind support received from external sources	• Total monetary and in-kind support received from external sources
Quality of collaboration	• Ratings of the quality of collaborations with different institution types • Number of grantees indicating which type of institution is their most effective collaborator	• Number of grantees indicating which type of institution is their most effective collaborator
Materials Development		
Purposes for materials development Results	• Number of grantees indicating different purposes for engaging in materials development • Number and types of materials (course, module, other) in various stages of development (draft, field tested, completed) • Number and type of materials in use in various ways (used locally or elsewhere; published commercially) • Number and type of materials with problem-solving tasks • Numbers of materials developed in various technology fields	• Number and types of materials in various stages of development • Number and type of materials in use in various ways • Numbers of materials developed for specific target audiences (secondary school, 2-year college, 4-year college, other) and stages of development • Number of copies of materials distributed and type of materials distributed beyond ATE grant • Number of external institutions using at least one developed material • Degree of national dissemination of developed materials

	Data Source(s)	
Indicator	**2000-2003**	**2004-2005**
Development practices	• Frequency of verifying workforce skills and industry needs • Frequency of using standards to guide development • Frequency of assessing student success in comparison with standards • Frequency of assessing students in comparison with nonproject students • Frequency of pilot testing materials • Frequency of field testing materials internally • Frequency of field testing materials externally	• Frequency of verifying workforce skills and industry needs • Frequency of using standards to guide development • Frequency of assessing student success in comparison with standards • Frequency of assessing students in comparison with nonproject students • Frequency of pilot testing materials • Frequency of field testing materials internally • Frequency of field testing materials externally
Quality	• Open-ended responses detailing evidence of materials quality	

Professional Development

Results	• Number of opportunities and participants for various types of professional development (conferences, workshops, in-service, internships, and online courses) • Number of participants from different education levels • Average capacity of opportunities	• Number of opportunities and participants for various types of professional development (events, events with follow-up, long-term contact programs, internships, self-study programs, other) • Number of participants from different education levels
Impact	• Number of grantees using different follow-up methods • Number of participants reporting level of implementation following the opportunities (satisfied, intend to use new ideas or materials, fully incorporated materials or ideas)	• Number of grantees using different follow-up methods • Number of participants reporting level of implementation following the opportunities (satisfied/intend to use, tried/fully implemented, student achievement increased)
Support	• Number of grantees requiring support for implementation as a condition of acceptance • Types of support provided for participants • Open-ended responses indicating examples of professional development outcomes	N/A

	Data Source(s)	
Indicator	**2000-2003**	**2004-2005**
Program Improvement		
Results	• Number of grantees engaged in program improvement at different levels (secondary, associate, baccalaureate) • Number of programs offered • Number of locations where programs are offered • Number of courses in programs • Number of students enrolled in at least one course • Number of new, changed, and unchanged courses in one specified ATE program	• Number of programs offered • Number of locations where programs are offered • Number of courses in programs • Number of students enrolled in at least one course
Changes in classroom environment due to project efforts	• Number of grantees reporting various changes in the classroom due to program improvement efforts	N/A
Articulation	• Number of grantees reporting different types of articulation agreements • Number of grantees reporting different purposes for articulation agreements • Number of grantees reporting that program credits transfer to higher education levels and extent to which credits transfer	N/A (see below)
Articulation Agreements		
Articulation	• Number of grantees reporting different types of articulation agreements • Number of grantees reporting different purposes for articulation agreements • Number of grantees reporting that program credits transfer to higher education levels and extent	• Number of articulation agreements • Number of institutions involved in agreements • Number of students who articulated in the past 12 months
Student Impact		
Demographics	• Gender of program applicants and enrolled students • Racial/ethnic makeup of applicants and enrolled students	• Gender of program applicants and enrolled students • Racial/ethnic makeup of applicants and enrolled students

	Data Source(s)	
Indicator	**2000-2003**	**2004-2005**
Recruitment and retention	• Methods used to recruit and retain students • Methods used to recruit and retain students from underrepresented groups	N/A
Outcomes	• Number of applicants • Number of enrolled students • Number of students employed as technicians prior to enrollment • Absolute and adjusted growth rates • Number of students completing the program • Of completing students, number who start/continue STEM education • Number of students leaving program • Of leaving students, number who start/continue STEM education	• Number of applicants • Number of enrolled students • Number of students employed as technicians prior to enrollment • Absolute and adjusted growth rates • Number of students completing the program • Of completing students, number who start/continue STEM education • Number of students leaving program • Of leaving students, number who start/continue STEM education

Appendix B:

ATE Survey Highlights
2000-2005

ATE Survey Highlights
2000-2005

This document highlights findings from the ATE evaluation survey, conducted annually from 2000 to 2005. The findings are organized according to the main elements of the 2005 solicitation synopsis (Program Solicitation, NSF 05-530, 2005). One element, applied research, is not addressed. The annual survey was completed by ATE principal investigators (or their designees).

Emphasis on 2-Year Colleges

- The majority of ATE grants (69% to 82%) were hosted by 2-year colleges.

- The number of 2-year college faculty participating in ATE-sponsored professional development activities more than doubled, from 4,322 in 2000 to 9,649 in 2005.

- In 2000, 60% of participants in ATE-sponsored professional development activities were engaged at the associate degree level (e.g., 2-year college faculty). By 2005, this group comprised just a third of participants, with secondary school personnel being the primary audience for these activities.

- Associate level programs developed with ATE support outnumbered new secondary and baccalaureate programs by factors of 3 and 13, respectively (2,066 versus 787 and 162).

- The total number of associate level programs created with ATE support outnumbered secondary and baccalaureate programs by factors of 11 and 22, respectively (16,842 versus 1,534 and 848). Associate level courses created or revised in 2005 alone nearly equaled all secondary level courses created/revised during the entire 6-year period and doubled the number of those at the baccalaureate level.

- The total number of associate-level students reached by the ATE program outnumbered secondary and baccalaureate students by factors of 7 and 48, respectively (324,391 versus 48.966 and 6,827).

- Almost three-fourths (72%) of articulation agreements established in 2004 and 2005 focused on the transition from high school to 2-year college programs.

Focus on Technician Education in High-Technology Fields

- The program made awards in 19 technology fields. Information technology (IT) received about one-sixth of all funding. Just over 80 percent of total funding was allocated to 9 fields (including "other" and "interdisciplinary") that individually received 5 percent or more of total funding. In addition to IT, these included manufacturing and industrial technology, semiconductor manufacturing, engineering technology, biotechnology, geographic information systems, and environmental technology.

- In 2004 and 2005, approximately 100 "on-the-job" technician training programs were developed.

- More than an average 60,000 students were enrolled in ATE-supported programs annually from 2000 to 2005.

Development of Partnerships Between Academic Institutions and Employers to Promote Improvement in STEM Education

- Annually, a large majority (80% to 90%) of ATE grants were engaged in collaborative efforts with non-ATE institutions, including business and industry and other educational institutions.

- In 2005, total additional funding provided by external collaborators was more than $34 million, largely from business and industry sources.

Curriculum Development Support

- More than 5,000 curriculum materials were produced, including more than 1,600 courses; 2,500 modules; and 1,100 other types of materials.

- ATE funds supported the development of more than 3,000 programs and the creation or revision of more than 19,000 courses.

- More than 70% of grantees annually reported that newly developed curriculum materials were aligned with workforce needs and/or used student or industry standards as development guidelines.

College and Secondary School Faculty Professional Development Support

- In 2005, ATE supported more than 2,000 professional development activities, including event-based programs (e.g., workshops and conferences), events with follow-up activities, internships, self-study, and other longer-term activities.

- Annually, the number event-based professional development activities was substantially larger than that of other professional development formats. Likewise, the number of projects engaged in event-based professional development was twice the number offering other types of professional development.

- More than 80,000 individuals participated in various professional development activities.

Development of Career Pathways from High School to 2-Year Colleges to 4-Year Colleges

- From 2000 to 2005, enrollment increased substantially in both the secondary school and 2-year college programs, from about 3,000 to 16,000 and from 3,000 to 50,000, respectively.

- The 6-year trend showed no rate gain in women's enrollment in ATE-supported programs, but some in underrepresented minority enrollment (5% for Latino/Hispanic; 10% for American Indian/Alaska Native).

- Most (1,479) of the 2,000 articulation agreements in 2004 and 2005 focused on the transition from high school to technician education programs at 2-year colleges.

Articulation Agreements between 2-Year and 4-Year Programs for Prospective K-12 Technological Education Teachers

- A total of 87 articulation agreements in 2004 and 2005 focused on 2-year colleges as feeder points for teacher preparation in technological education.

- On average, each 2-year college involved in articulation agreements engaged about 3 or 4 different 4-year colleges per agreement.