Assessing the Impact and Effectiveness of the Advanced Technological Education (ATE) Program

2004 Survey Results

Volume II
Status of the ATE Centers

Chris L. Coryn, Arlen R. Gullickson, and Carl E. Hanssen

The Evaluation Center
Western Michigan University
Kalamazoo, MI 49008-5237

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Contributors

Principal Authors ..... Chris L. Coryn
..... Arlen R. Gullickson
..... Carl E. Hanssen

Principal Investigator ..... Arlen R. Gullickson

Senior Associate/Co-Principal Investigator ..... Frances Lawrenz

Project Manager/Co-Principal Investigator ..... Carl E. Hanssen

Research Assistant/Data Analyst ..... Chris L. Coryn
..... Daniela C. Schröter

Technology Specialists ..... John Kapenga
..... Nate McFeters
..... Helio Vogel

Editor ..... Sally Veeder

Executive Summary

The Advanced Technological Education (ATE) program is a federally funded program designed to educate technicians for the high-technology disciplines that drive the United States' economy. As stated in the ATE program guidelines,[1] this program:

> Promotes improvement in technological education at the undergraduate and secondary school levels by supporting curriculum development; the preparation and professional development of college faculty and secondary school teachers; internships and field experiences for faculty, teachers, and students; and other activities

ATE funds three program tracks: projects, centers, and articulation partnerships. This report addresses the status of the ATE centers in regards to these program guidelines and is part of the larger effort to evaluate the ATE program. Presently, ATE funds three types of centers: National Centers of Excellence, which typically focus in one disciplinary area with the intent of making a national impact in that field; Regional Centers for Manufacturing and Technology, which are intended to have a local impact in key technological disciplines; and Resource Centers that are typically iterations of successful projects that are positioned to disseminate exemplary materials and provide support for other organizations engaged in technological education improvements.

This report, Volume II of the 2004 ATE Annual Survey Report, specifically addresses the following fundamental elements of the ATE Centers:

1. What are the size and scope of work for ATE centers?
2. To what degree do ATE centers apply rigorous internal practices in their operations?
3. How extensive are ATE center collaborations?
4. How productive are ATE centers in terms of the primary ATE work categories?
5. What impact are ATE centers having on students?

These questions are keyed to the primary evaluation indicators used to monitor the performance of ATE grantees. Additional questions, specifically the relative contribution of ATE centers as compared with the ATE projects, are addressed in Volume I of this report and through other evaluation products.

The 2004 ATE Survey contained seven sections, three required and four supplementary. The three required sections were (1) grantee characteristics, (2) organizational practices, and (3) collaboration. In addition to the three required survey sections, respondents were asked to complete additional sections based on their program's efforts. These four supplementary sections were directly aligned with the primary focus of ATE efforts: (1) materials development, (2) professional development, (3) program improvement, and (4) articulation agreements. Thus, the 2004 ATE Survey was structured as follows (also see the notes at the end of this report):

[1] Advanced Technological Education (2002). *Program Solicitation NSF-02-035*.

I. Required sections
   1. Grantee Characteristics
   2. Organizational Practices
   3. Collaboration

II. Supplementary sections
   4. Materials Development
   5. Professional Development
   6. Program Improvement
   7. Articulation Agreements

Although sections 4 through 7 were "supplementary," ATE program guidelines indicate that centers should engage in all of these activities. Therefore, these sections should have been completed by all of the responding centers, but were not. Twenty-one ATE centers responded to all or portions of the 2004 ATE Survey. Of these, 9 were National Centers of Excellence, 7 were Regional IT Centers, 1 was a Regional Manufacturing Center, and 4 were Resource Centers. Twelve (57%) centers completed the materials development section, 17 (81%) completed the professional development section, 15 (71%) completed the program improvement section, and 11 (52%) completed the articulation agreements section.

Size and Scope of the ATE Centers

The ATE centers are implementing the program as designed. The majority of centers (91%) are hosted by two-year colleges. Moreover, the centers are heavily engaged in the major categories of ATE work, that is, materials development (57%), professional development (81%), program improvement (71%), and articulation agreements (52%). The ATE centers are widely distributed across the United States. Moreover, 4,404 students completed center programs; 2,192 center students started or continued employment as technicians; and 1,221 center students started or continued STEM education (see Student Impact for more detailed information).

Internal Practices

The ATE centers are actively engaged in rigorous elements of operation such as and the use of advisory committees (p. 9), evaluative efforts (p. 11), and program monitoring by NSF (p. 12). In addition, half of ATE centers reported conducting an assessment of workforce needs in the previous 12 months (p. 10). Each of these internal practices is intended to guide and inform the efforts of the ATE centers.

Extent of Center Collaborations

Collaborative arrangements are in place with numerous external agencies and organizations as well as internally with the respondents' host institutions. Respondents reported 2,041 collaborative partnerships with ATE and non-ATE agencies, organizations, and/or institutions (p. 14). These collaborative agreements serve a number of purposes including monetary and in-kind support, general program support, development of materials, professional development for educators, improving center programs, and articulation, among others (p. 14-16).

Center Productivity in ATE Work Categories

Indicative of the ATE centers' size and scope of work, centers are producing vast quantities of materials (p. 19), providing professional development opportunities for educators (p. 22), developing programs across numerous locations (p. 28), serving students (p. 30), and providing students pathways to higher level technological education (p. 33).

Student Impact

The ATE Centers are proactively and positively impacting students and the technological workforce of the United States through their efforts. That is, large numbers of students are completing center programs and continuing/starting employment as technicians or continuing/starting STEM education (p. 38). Overall, the number of students completing center programs exceeds those who fail to complete (drop out) by an almost 2:1 ratio (p. 41).

Overall Assessment

The ATE centers perform well in *setting the stage*, that is, that ATE-funded centers are consistent with the program's federal mandate. The centers are comprehensive in scope and are engaging in multiple ATE work-related activities, which emphasize a wide range of technological disciplines. This in turn leads to the application of sound organizational practices. These practices include employing advisory committees and evaluative efforts, as well as assessing workforce needs, for example. Moreover, strong cooperative efforts between the ATE centers and other institutions and organizations are occurring. Thus, the ATE centers are *setting the stage* for success.

In each of the four *program elements*—primary categories of work—a small number of ATE centers are excelling. By and large, single centers are highly productive in one or more of the work categories, inflating overall numbers (e.g., of the 10,000 professional development participants almost 7,000 were from a single ATE center). This occurred across all 4 categories of work (materials development, professional development, program improvement, and articulation agreements). Single, highly productive centers contribute substantially greater efforts and outcomes than the combined efforts of the others.

The ATE centers' achievement of *program goals*—to increase the number and quality of technicians in the United States and, as a result, positively impact the workforce in technological disciplines—is occurring, because the ATE centers are serving a large number of students. Yet, the number of female students enrolling in and completing center programs has declined from 2003 to 2004 (from 35% to 31%).

Recommendations

1. *Encourage the ATE centers to engage in programming in each of the 4 primary ATE work categories*. Evidence shows that this is not the case; only 38 percent of centers engage in all 4 work categories. Given the expectations that ATE centers provide comprehensive programming and the levels of funding that they receive, they are best positioned to integrate materials development, professional development, program improvement, and student articulation within the ATE program.

2. *Encourage the ATE centers to directly leverage the work of other ATE grantees and integrate this work into their programming*. Centers have a strong network of ATE collaborations that can be leveraged for these purposes. Individual centers can promote comprehensive programming by collaborating with specific ATE projects that may be more directly focused in one area (e.g., professional development) and then adapt and implement project programs at the center level.

3. *Encourage the ATE centers to increase advisory panel and evaluation expenditures*. Centers spend less than the NSF-recommended 5 percent on evaluation and less than $7,000 per center annually for advisory panels. Increasing the investment in evaluation can help provide some of the hard evidence that is lacking about the effectiveness of center programs. For evaluation, this means budgeting between 7-10 percent of the grant for evaluation purposes. For advisory panels, this may constitute budgeting for honorariums and all meeting expenses.

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Status of the ATE Centers

This report presents results from the fifth annual survey[2] of Advanced Technological Education (ATE) projects, centers, and articulation partnerships, collectively *projects*. This survey is part of larger effort to evaluate the ATE program. When combined with other information[3] and criteria, these findings provide a basis for judging the overall impact and effectiveness of the ATE program. Findings from this survey are expected to be useful to NSF staff in preparing their annual reports to Congress and for making programmatic decisions. Recipients of ATE grants are likely to use survey results to learn about the activities and findings of other grantees and to serve their own improvement needs.

ATE has approximately 220 active awards. Of these, 163 ATE-funded projects, centers, and articulation partnerships were asked to participate in the 2004 survey.[4] During the survey administration period, 5 projects were removed from the sample, resulting in a final target sample of 158 grantees. Of these, 154 (97%) responded to all or portions of the survey.

The ATE program's grantees are expected to develop materials, improve instructional programs, provide professional development to STEM faculty, and establish articulation agreements that enable students to further their education. Grantees are expected to collaborate with business, industry, one another, and other education institutions. These efforts are directed primarily at the associate degree level through two-year and technical colleges, but they also impact the secondary and baccalaureate education levels.

In an effort to provide targeted information for various audiences, we have broken this report into three volumes. Volume I examines four important program design characteristics and provides evaluative judgments about the program. Volume II reports the status of ATE centers with regard to their efforts in each of the work categories. Volume III does the same for the combined set of projects and articulation partnerships.

In addition to this report, summarized survey data are available through interactive data displays that can be accessed at www.ate.wmich.edu/sv/home.

[2] The first ATE survey was conducted in May 2000. Subsequent surveys were conducted in February of 2001, 2002, 2003, and 2004.
[3] All reports and products from the ATE program evaluation can be accessed at www.ate.wmich.edu.
[4] For a description of the sample selection criteria and survey structure, refer to the notes at the end of this report.

This volume of the report addresses the status of ATE Centers. ATE program guidelines[5] state that ATE centers are comprehensive national or regional resources that provide models and leadership for other projects and act as clearinghouses for educational materials and methods. Their work activities are intended to be comprehensive in scope and based on a strong alliance between NSF, the host institution, and business and industry.

ATE awards grants for three types of centers: National Centers of Excellence, Regional Centers for manufacturing and technology, and Resource Centers. National Centers of Excellence typically focus on one disciplinary area with the intent of making a national impact in that field. Regional Centers for manufacturing and technology are intended to have a regional impact in these key technological disciplines. Resource Centers are typically continuations or extensions of successful projects that are positioned to disseminate exemplary materials and provide support for other organizations engaged in technological education improvements.

In reporting survey results for ATE centers, several questions guided our work:

1. What is the size and scope of work for ATE centers?
2. To what degree do ATE centers apply rigorous internal practices in their operations?
3. How extensive are ATE center collaborations?
4. How productive are ATE centers in terms of the primary ATE work categories?
5. What impact are ATE centers having on students?

These questions are keyed to the primary evaluation indicators used to monitor the performance of ATE grantees.

[5] The 2002 program solicitation [Advanced Technological Education (2002). *Program Solicitation NSF-02-035*] provides the frame of reference for this report because the first time grants awarded under this solicitation were invited to participate in the annual survey was 2004 due to the sample selection criteria described in the notes to this report.

Center Size and Scope

In 2004, 21 ATE centers responded to the annual survey, representing 14 percent of the total responses (21 of 154). Nine were National Centers of Excellence, 7 were Regional IT Centers, 1 was a Regional Manufacturing Center, and 4 were Resource Centers. Consistent with ATE program guidelines, the ATE centers are primarily hosted by two-year colleges (91%); 1 (5%) reported being from a 4-year college and 1 (5%) reported being hosted by some "other" institution type.

As illustrated in Figure 1, the ATE Centers are distributed widely across the United States.

Note. *N* = 21.

Figure 1: Geographical Distribution of ATE Centers

Longevity is the difference between the start date for the 2004 ATE Survey and the start date of the respondents' award[6] (including antecedent awards). While none of the 21 centers sampled in the 2004 ATE Survey reported receiving funding for 4 or more years, ATE award data indicated that the majority of these centers (63%) were active for more than 4 years and had antecedent awards. All centers that were funded for less than 3 years (38%) and had not received previous ATE awards are highlighted in Table 1. This table also indicates that the largest number of centers (39%) were between the ages of 4 to 8 years. A smaller proportion of centers (24%) had been active for more

[6] Planning grants were not included for purposes of determining ATE centers' age or longevity.

than 8 years. Longevity plays a key role in ATE center activities as will be illustrated throughout this report.

Table 1: Center Longevity

Age in Years	*N*	*%*
<1	1	5%
1-2	3	14%
2-3	4	19%
4-5	1	5%
5-6	3	14%
6-7	2	10%
7-8	2	10%
8-9	2	10%
9-10	3	14%

Note. *N* = 21.

Over a period of 4 years, ATE typically awards National Centers of Excellence up to $5 million, Regional Manufacturing or IT Centers up to $3 million, and Resource Centers up to $1.5 million. ATE projects and articulation partnerships generally receive awards between $25,000 and $300,000 per year, with articulation partnerships usually receiving less than $100,000 annually. As Table 2 illustrates, the average award given to an ATE center (*M* = $1,730,720) is 3 times greater per award than ATE projects (*M* = $532,411) and nearly 5 times greater than for an ATE articulation partnership (*M* = $302,616). However, across all grants the current total support given to ATE projects (including ATE articulation partnerships) is nearly double that for ATE centers with $68,972,322 (*N* = 133) versus $36,345,113 (*N* = 21) respectively. Complete ATE project and articulation partnership award data can be found in Volume III: Status of the ATE Projects.

Table 2: Center Award Amounts

Center Type	*M*	*SD*	Total
National Center of Excellence	$2,034,976	$1,127,887	$18,314,780
Regional Center for Manufacturing	$2,000,000	$0	$2,000,000
Regional Center for IT	$1,687,905	$999,406	$11,815,333
Resource Center	$1,053,750	$297,584	$4,215,000
Total	$1,730,720	$979,470	$36,345,113

Note. *N* = 21.

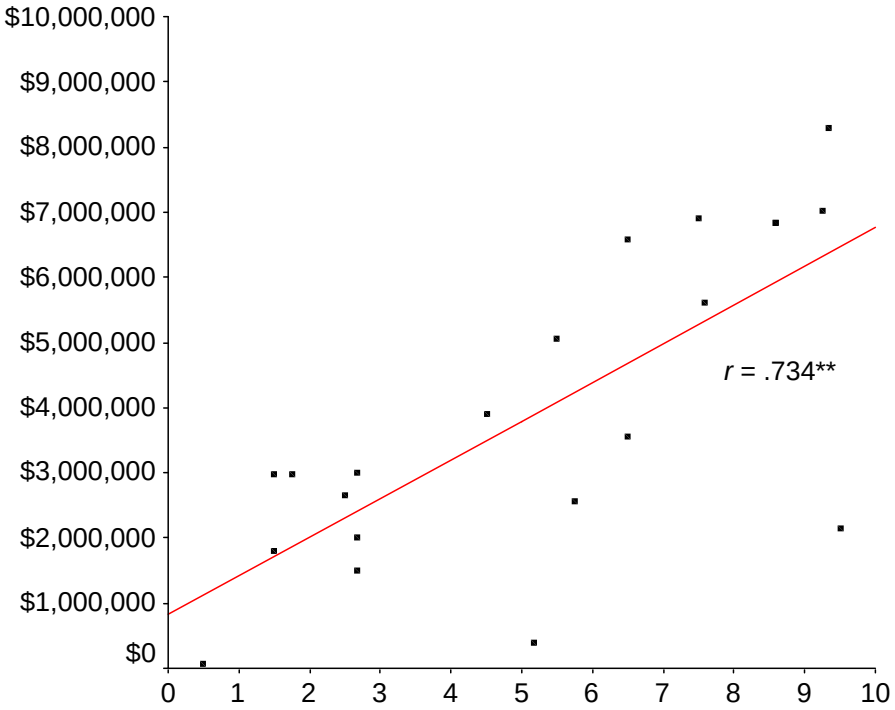
In addition to their current awards, ATE centers had on average 1.5 antecedent ATE awards. The recipients of these multiple awards received an average of $3.8 million (see Table 3) over a 5-year period (*M* = 5.2 years), with one of the oldest centers (9.3 years) receiving a total of $8,285,233 over its lifetime.

Table 3: Center Funding Over Life Cycle

Center Type	*M*	*SD*	Total
National Center of Excellence	$4,270,076	$2,313,310	$38,430,685
Regional Center for Manufacturing	$2,000,000	$0	$2,000,000
Regional Center for IT	$2,090,540	$999,089	$14,633,785
Resource Center	$6,914,269	$1,337,273	$20,742,807
Total	$3,790,363	$2,374,819	$75,807,277

Note. *N* = 21.

Figure 2 displays ATE center longevity and total funding received. Total award represents the sum of the current award and all antecedent awards except planning grants. Age in years illustrates longevity, that is, the difference between the start date of the 2004 ATE Survey and the start date of the respondent's award, including antecedents but not planning grants. As would be expected, the older an ATE center, the greater the total funding received.



Note. ** Correlation is significant at *p* = .01 level.

Figure 2: Center Longevity and Total Funding Received

The ATE centers focused on a broad array of disciplinary coverage. Of the 20 categories of technological emphasis established by ATE,[7] the 21 responding ATE centers indicated activity in 10 different technology disciplines. Table 4 illustrates the

[7] Advanced Technological Education (2002). *Program Solicitation NSF-02-035*.

variety of technological fields stressed by the ATE centers, with those fields not covered removed (i.e., aquaculture, electronics, geographic information systems, graphics and multimedia, machine tool technology, mathematics, general multi- or interdisciplinary, or physics).

Table 4: Centers' Technology Emphases

Technological Fields	***N***	***%***
Agriculture	1	5%
Biotechnology	1	5%
Chemical Technology	1	5%
Engineering Technology (General)	3	14%
Environmental Technology	1	5%
Information Technology, Telecommunications	7	33%
Manufacturing & Industrial Technology	1	5%
Marine Technology	1	5%
Semiconductor Manufacturing	1	5%
Transportation	1	5%
Other	3	14%

Note. *N* = 21.

Information technology/telecommunications (33%), engineering technology (14%), and "other" technologies (14%) were reported most frequently. Other technologies emphases included aerospace technology, nanotechnology, and “connecting technologies”. The “connecting technologies” discipline was described as follows:

> We work in what we've defined as connecting technologies which refers to all the network mediums, tech hardware that interconnects these network mediums, the software that enables and manages the flow of all forms of traffic over these interconnected networks utilized by ICT-enabled industries, traditional and emerging.

The high frequency of the information technology/telecommunications (33%) as a focus of disciplinary activities is explained by the fact that 8 of the 21 responding ATE centers were Regional IT Centers comprising 38 percent of the total sample.

Moreover, the ATE centers reported engaging in a variety of programmatic activities (see Table 5) related to their primary disciplinary emphases. Nineteen of the 21 responding ATE centers indicated professional development activities (90%) and three-fourths indicated engagement in program improvement activities (76%). The ATE centers also reported other activities (e.g., materials development for national dissemination, technical experiences, and articulation agreements) in which they were active.

Table 5: Center Engagement in Programmatic Activities and Work Categories

Programmatic Activities	***N***	*%*
Materials Development for National Dissemination	13	62%
Professional Development	19	90%
Program Improvement	16	76%
Technical Experiences (Internships, Summer Camps, etc.)	11	52%
Laboratory Development	5	24%
Research	3	14%
Articulation Agreements	10	48%
Other	5	24%
Work Category	***N***	**%**
Materials Development	12	57%
Professional Development	17	81%
Program Improvement	15	71%
Articulation Agreements	11	52%

Note. *N* = 21.

These data support that ATE centers collectively engage in the complete range of ATE activities, that is, "acting as a clearinghouse for educational materials and methods, providing teachers and faculty with opportunities for continued professional growth, and improving programs in order to impact students,"[8] among others. Individually, the centers are more narrowly focused in their efforts.

Survey respondents were asked to complete additional sections of the survey to elaborate on their center's primary work activities. Each center completed one or more of these four added sections. Figure 3 shows the descriptions that centers used as a basis for deciding whether to complete the respective sections.

The intent of these sections was to describe the primary efforts of centers, not all work conducted by them. Therefore, a center may have reported conducting work in all four categories, but completed fewer sections to describe the center's primary work (Table 5). Overall, however, they show a high degree of correspondence. Except for small differences for professional development and articulation, response rates for primary work corresponded with the center's stipulations regarding types of work it conducts.

[8] Advanced Technological Education (2002). *Program Solicitation NSF-02-035*.

Materials Development activities result in textbooks, laboratory experiments and manuals, software, CD-ROMs, videos, or other courseware that will be published for national distribution to colleges, secondary schools, or industry.

Professional Development provides current secondary teachers and college faculty with opportunities for continued professional growth in areas that directly impact advanced technological education.

Program Improvement activities enhance a curriculum in multiple ways, producing a coherent sequence of classes, laboratories, and work-based educational experiences that revitalize the learning environment, course content, and experience of instruction for students preparing to be science and engineering technicians. The improved program leads students to an appropriate degree, certification, or occupational competency point and provides industry with a larger pool of skilled technicians.

Articulation Agreements are 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. This addresses both articulation agreements for students preparing for careers as technicians as well as teacher preparation agreements.

Figure 3: ATE Program Work Categories

While Table 5 does not display combinations of primary work activities conducted by these centers, it does show that most identify multiple categories as primary work areas. As can be seen in Table 6, only 38 percent of respondents indicated activity in all four of ATE's major work activities.

Table 6: Center Engagement in Combinations of Work

Combinations of Work	***N* and %**
All 4 activities	8
% of total	38%
3 of 4 activities	5
% of total	24%
2 of 4 activities	3
% of total	14%
1 of 4 activities	2
% of total	10%
0 of 4 activities	3
% of total	14%

Note. *N* = 21.

Internal Practices

We used four indicators to gain insight into the rigor of ATE centers. These indicators focus on information and processes that centers employ to guide their work, including use of advisory committees, conducting workforce needs assessments, evaluation, and monitoring.

The first indicator, use of advisory committees, was chosen because NSF encourages their use, especially for large projects and centers. NSF expects that centers will form a National Visiting Committee (NVC) with the advice and consent of the NSF program officer. Additionally, centers are encouraged to form and use advisory committees to assist in guiding activities, provide support, and collaborate on center work. These advisory committees may be national committees, regional committees, local committees, or others specified by the ATE Center. Ninety-five percent of respondents indicated having at least one type of advisory committee.

NSF does not dictate how many advisory committees a center should use. Certainly there are trade-offs in terms of information gained versus work required to inform and engage these committees. A large majority, 85 percent, reported having a national committee. A majority (55%) also have at least one additional committee. One center reported having four types of advisory committees, six (29%) centers reported having three types of advisory committees, and four (19%) reported having at least two types of advisory committees. Thirty-five percent have regional committees, 50 percent have local committees, and 10 percent had other types of advisory committees.

National Visiting Committees are expected to submit a written report of their meetings and findings. Survey findings do not distinguish which projects had NVCs, but survey responses indicate that centers do comply with such expectations. Seventeen of 19 (89%) responding centers reported receipt of a written report from their advisory committee(s) in the past 12 months.

Respondents strongly agree (N = 19, M = 4.7, SD = 0.5) that advice received from their advisory committees has been useful.[9] The utility of that information is balanced against an overall cost of $133,735 that centers paid for these advisory committees in the past 12 months. This is slightly more than $7,000 per center ($N$ = 18, M = $7,429.7, SD = $3,992.7). That modest amount suggests that many advisors provide their services gratis with only travel and per diem costs paid for their involvement.

Representative statements from ATE centers describing strengths and limitations associated with their advisory committees are illustrated in Figure 4. A major strength of advisory committees is diversity of constituencies involved, while time constraints of committee members were reported as key limitations.

[9] From 1 = strongly disagree to 5 = strongly agree.

Strengths	Weaknesses
✓ Currency with the industry and an understanding of the role of community and technical colleges in workforce preparation ✓ The positive impact of the advisory committees to the center is maximized because of the breath of representation and ongoing commitment of members and their perception as true partners with the center. ✓ Objective, constructive criticism and recommendations for improvement from national experts ✓ The committee members represent education, industry, and professional organizations, giving us a broad set of observations. They are very astute and freely offer advice, constructive criticism, and suggestions for continuous improvement.	✓ The availability of advisory committee members is limited by time constraints of managing multiple priorities. ✓ Their time available to work on NVC activities is somewhat limited. ✓ Members are very busy and don't have a lot of time to contribute to the project; difficult to coordinate schedules to facilitate meetings; some members have a very specific point of reference and have difficulty divorcing their own perspectives/needs. ✓ Bureaucratic state requirements have hampered our ability to respond to their advice.

Figure 4: Strengths and Weaknesses of Center Advisory Committees

Needs assessments, our second indicator of rigor, are viewed as important, even crucial tools, for planning and guiding work (Fitzpatrick, Sanders, & Worthen, 2004; Stufflebeam, Madaus, & Kellaghan, 2000). All centers indicate they have used needs assessments at some point, and half (50%) report having conducted a needs assessment within the past 12 months. Twenty centers described how workforce needs assessments were conducted, what they learned, and how the information from these assessments was utilized. Figure 5 summarizes information from those open-ended responses.

How Were Workforce Needs Assessments Conducted?	What Was Learned?	How Were They Used?
✓ Surveys (industry representatives, employers, and businesses) ✓ Focus groups (industry representatives, employers, businesses) ✓ Advisory panel meetings	✓ Larger companies have the potential for growth. ✓ Current and projected employment market ✓ Course, curriculum, and materials content needs ✓ New requirements for workplace	✓ Future products and services ✓ Curriculum design and competencies ✓ Pilot program development (including laboratories and materials) ✓ Development of instructional materials ✓ Program improvement

Figure 5: Needs Assessments: Implementation, Outcomes, and Utilization

Evaluation, the third indicator of project rigor, is widely viewed as a key element to improving project planning and implementation and to assessing the merit and worth of project accomplishments. The ATE program mandates evaluations for projects it funds; and the EHR directorate encourages expenditure of from 5 to 10 percent of each project's costs on evaluation (*User Friendly Handbook for Project Evaluation: Science, Mathematics, Engineering, and Technology Education*, 1993). These evaluations are intended to serve the ATE centers in a number of ways, for example, program

documentation, monitoring, or for purposes of program improvement. These evaluations may be conducted by internal, external, or by both types of evaluators.

Of the 20 ATE centers that responded to this section, 17 (85%) indicated employing an evaluator and 16 (80%) reported having received a written report from their evaluator(s) within the past 12 months. Of these, 14 centers (70%) had an internal evaluator and 3 (15%) utilized both internal and external evaluators. None of the ATE centers employed the services of an external evaluator exclusively.

The 17 centers reported spending in total slightly more than 1 percent ($401,394/$33,990,300)[10] of their grant for evaluation work during the past year. Since ATE centers typically are funded for 4 years, this indicates that, overall, the centers spend close to 5 percent of their budgets across the full funding period.

The three centers not engaging evaluators were either “old” or “young.” Two belonged to the group of four centers that had been active for more than 8 years. The third non-evaluating ATE center was the youngest center of the total sample (see Table 1, p. 4).

The centers that employ evaluators uniformly find the evaluations useful. Respondents strongly agree both that that evaluations are essential to their work (*N* = 17, *M* = 4.7, *SD* = 0.5) and that evaluations provide evidence about the quality of project outcomes. Figure 6 elaborates on respondents' perspectives of the value of evaluations [i.e., the most important strengths and weaknesses of their evaluator(s) and evaluation(s)]. The strengths point to the power of evaluations for project improvement. The drawbacks of evaluation are manifest in their resource intensiveness, that is, time (both center and evaluator) and money (cost).

Strengths	Weaknesses
✓ Objective, constructive criticism and recommendations for improvement	✓ "Evaluation is often reactive to advisory committee"
✓ Always willing and available for assistance	✓ "Time/dollars"
✓ An outside view that can challenge the center to respond	✓ "Allocating time for conducting evaluation activities"
✓ Evaluators provide good qualitative data and insight based on years of experience.	✓ "They will require more time to get quantitative data of program outcomes."
✓ Strong personal commitment to project success	✓ "The evaluator does not have enough time to conduct all of the follow-up and reporting required by the magnitude of the project."

Figure 6: Strengths and Weaknesses of Center Evaluation

NSF holds the ATE centers accountable through annual reports and National Visiting Committees. Additional opportunities to engage in further activities that serve to reinforce center relationships with NSF are provided through NSF guidance and feedback on ATE center activities as well as through improved collaborations with other

[10] Only the ATE centers that indicated having an evaluator and the amount allocated for evaluation were included.

projects and centers. These activities are collectively referred to as monitoring, the fourth indicator used here to measure project rigor.

Centers uniformly interact with NSF in multiple ways (see Table 7). Approximately two-thirds of the centers engaged in five or more types of interactions with NSF staff; a fifth (20%) reported its involvement in all possible activities, and 45 percent reported participating in five to six of these activities.

Table 7: Center Interactions with NSF

Interaction Types	***N***	**%**
Site Visits by NSF	11	55.0%
Site Visits by Center to NSF	10	50.0%
Telephone Calls to/from NSF	17	85.0%
E-Mail Contacts with NSF	20	100.0%
Attendance at Principal Investigator Meetings	19	95.0%
NSF Reading and Reaction to Written Reports	9	45.0%
NSF Recommendations for Improving Center Work	14	70.0%

Note. *N* = 20.

As Table 7 shows, all centers are reached via e-mail, and nearly all have at least one face-to-face meeting with NSF annually via the Principal Investigators meeting. Those two activities, in conjunction with telephone calls, likely serve as major interaction tools. A fourth category, NSF reading and reaction to written reports, is also noteworthy because it is the only category noted by less than a majority of the centers. A much larger percentage report obtaining NSF recommendations for improving center work than getting feedback based on their written reports. This suggests that recommendations tend to be based more on personal interactions and "nonreport" exchanges (e.g., telephone calls and e-mail messages).

Respondents view NSF staff positively (see Table 8). They reported that NSF was responsive in meeting their needs, that evaluative actions by NSF improved the quality of their work, that NSF facilitated collaboration with other ATE awards, and that NSF accurately understands the ATE centers.

Table 8: Center Perceptions of NSF[11]

Perceptions	***N***	***M***	***SD***
NSF is Responsive in Meeting Center Needs	20	4.8	0.4
NSF Evaluative Action has Improved the Quality of our Work	20	4.5	0.5
NSF Facilitates Collaboration with Other ATE Awards	19	4.7	0.5
NSF has Accurate Understanding of Center	20	4.7	0.5

Note. *N* = 20.

[11] From 1 = strongly disagree to 5 = strongly agree.

The findings from this section are positive in terms of all four indicators (use of advisory committees, conducting workforce needs assessments, evaluation, and monitoring.) While one may quarrel with the indicators (e.g., other indicators might be better), the survey findings show that the centers uniformly engage in all of these processes. The findings also suggest that more can be done in each of these areas. For example, the typical center spends somewhat less than the recommended minimum for evaluation purposes and wishes that more time were available for evaluation work. At the same time the centers worry about the costs for evaluations. NSF staff members get strong marks for their responsiveness to centers and their knowledge of the centers. However, the rather low percentage of centers getting feedback on their written reports suggests NSF staff members might serve them better through careful review and feedback of those reports.

Extent of Center Collaborations

The ATE program encourages the development of collaborative activities to promote improvement in technological education. Centers completed this section of the 2004 ATE Survey if they had collaborations with other ATE *projects* or with non-ATE institutions. The following operational definition of collaboration was established for the survey:

> 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, partnerships, and the host institution.

Collaborations with ATE projects

Sixteen centers (76%) reported 106 collaborations with other ATE-funded *projects,* an average of approximately 7 such collaborations per center (*N* = 16, *M* = 6.6, *SD* = 6.6) (see Table 9). Moreover, 5 of these centers received monetary support and 11 centers received in-kind support from other ATE project collaborators.

Table 9: Number of Center Collaborations With Other ATE Projects

	Total	***M***	***SD***	***N***	**%**
Number of Collaborations	106	6.6	6.6	16	76%
Number Providing Monetary Support	11	2.2	1.3	5	24%
Number Providing In-Kind Support	32	2.9	2.3	11	52%

Note. *N* = 21.

The collaborations between centers and other ATE-funded *projects* served four predominant purposes: general support, materials development, professional development, and program improvement. Each of those purposes was listed by four separate centers. No center indicated articulation agreements as the purpose of collaborative activities.

Non-ATE collaborations

All 21 ATE Centers indicated collaborations with non-ATE institutions such as business and industry, host institutions, other education institutions, public agencies, and other organizations. Every center received collaborative support from its host institution and collaborated with one or more other educational institutions as well. Nearly all (95%) also indicated partnerships with business and industry; two-thirds (67%) indicated alliances with public agencies and other institutions respectively.

The reported number of collaborations is large. For example, centers reported forming 840 collaborations with other education institutions and 167 partnerships with host institutions. Twenty responding centers indicated a total of 733 collaborations with business and industry. Those figures suggest that each center engaged in more than 80 collaborative efforts (ongoing relationships) in the past year.

Respondents were asked to identify whether the support was monetary or in-kind in nature. As Table 10 shows, in-kind support for collaborative efforts occur nearly twice as frequently as do collaborations providing monetary support. Additionally, business and industry appear to be prime contributors, at least in terms of numbers of collaborations providing monetary support. Though less than half of the centers identify monetary collaborative arrangements with business and industry, the number of those collaborations (91) nearly equals the total number of money-based collaborations with other types of institutions (96).

Table 10: Number of Collaborations With Non-ATE Institutions

Collaborators		**Total**	***M***	***SD***	***N***	**%**
Business/ Industry	Number of Collaborations	733	36.7	44.5	20	95%
	Number Providing Monetary Support	91	10.1	7.3	9	43%
	Number Providing In-Kind Support	530	33.1	48.6	16	76%
Host Institution	Number of Collaborations	167	7.9	18.8	21	100%
	Number Providing Monetary Support	25	1.8	2.1	14	67%
	Number Providing In-Kind Support	126	7.4	19.3	17	81%
Other Educational Institutions	Number of Collaborations	840	40.0	52.7	21	100%
	Number Providing Monetary Support	46	5.8	6.6	8	38%
	Number Providing In-Kind Support	481	32.1	58.5	15	71%
Public Agencies	Number of Collaborations	78	5.6	5.6	14	67%
	Number Providing Monetary Support	16	2.7	2.1	6	29%
	Number Providing In-Kind Support	58	6.4	6.8	9	43%
Other Organizations	Number of Collaborations	117	8.4	12.9	14	67%
	Number Providing Monetary Support	9	2.2	1.9	4	19%
	Number Providing In-Kind Support	90	10.0	16.0	9	43%

Note. *N* = 21.

These collaborative efforts served a number of program-related purposes, materials development, professional development, program improvement, and articulation agreements. Overall, collaborative partnerships were for general support (see Table 11). More diverse purposes were served by partnerships with business and industry and other education institutions. Centers frequently collaborated with business and industry for program-related activities such as professional development and program

improvement. In the case of other education institutions, collaborations were for developing materials, improving programs, and professional development.

Table 11: Purpose of Center Non-ATE Collaborations

	Purposes for Collaborations	***N***	**%**
Business/ Industry	General Support	7	33%
	Materials Development	1	5%
	Professional Development	3	14%
	Program Improvement	7	33%
	Articulation Agreements	0	0%
	Other	2	10%
Host Institution	General Support	16	76%
	Materials Development	1	5%
	Professional Development	1	5%
	Program Improvement	1	5%
	Articulation Agreements	1	5%
	Other	1	5%
Other Education Institutions	General Support	6	29%
	Materials Development	3	14%
	Professional Development	1	5%
	Program Improvement	5	24%
	Articulation Agreements	4	19%
	Other	1	5%
Public Agencies	General Support	9	43%
	Materials Development	2	10%
	Professional Development	3	14%
	Program Improvement	2	10%
	Articulation Agreements	0	0%
	Other	0	0%
Other Organizations	General Support	7	33%
	Materials Development	0	0%
	Professional Development	3	14%
	Program Improvement	2	10%
	Articulation Agreements	0	0%
	Other	1	5%

Note. *N* = 21.

Overall, the 21 ATE centers received a combined total of $15,328,080 in monetary and in-kind assistance. That is, 15 centers reported receipt of $7,098,933 in monetary support (*N* = 15, *M* = $473,262.2, *SD* = $995,583.7) and 18 ATE Centers reported receiving a total of $8,229,147 of in-kind assistance (*N* = 18, *M* =$457,174.8, *SD* = $1,140,576.5). However, taken as a whole no linear relationship was evident between

the ATE award amount centers received and the combined external support (monetary and in-kind). As can be seen in Figure 7, however, a single ATE center accounted for $9,000,000 of the $15,328,080 received, or 59 percent.

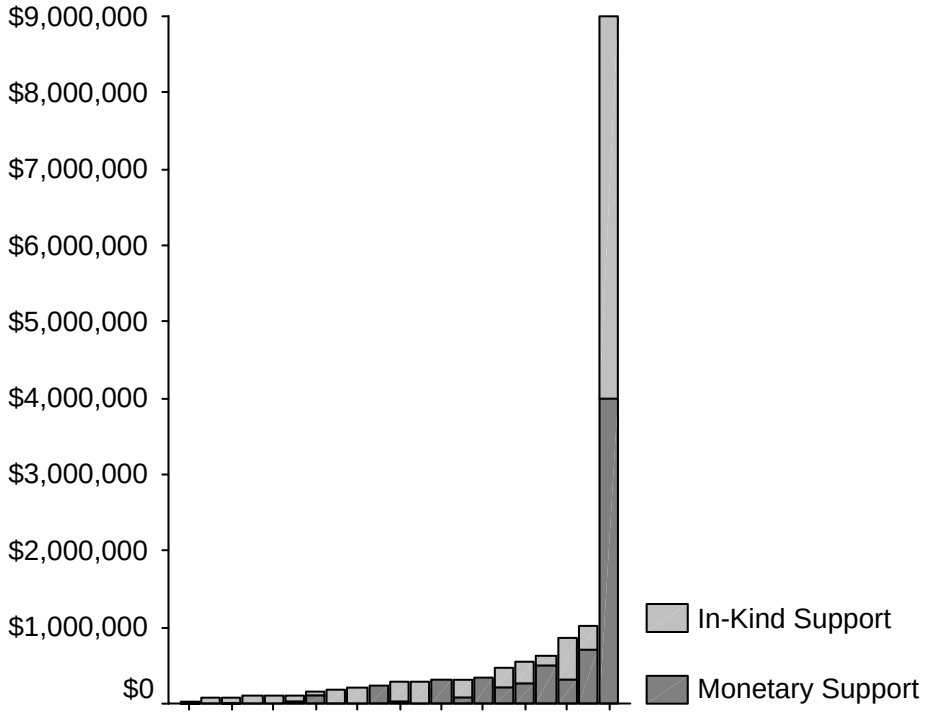


Figure 7: Combined Monetary and In-Kind Support[12]

With regard to the effectiveness of collaborations with ATE-funded projects or non-ATE institutions, the majority of centers rated business and industry groups (43%) as most effective, followed by other educational institutions (33%) and their host institution (19%). No center indicated that collaboration with other ATE awards or public agencies had been most effective.

Respondents were also asked to state their view of the most important elements for effective collaboration with external organizations. Figure 8 provides representative statements of ATE Centers' views of the most important elements of effective collaboration.

[12] The horizontal axis represents individual ATE Centers.

Most Important Elements for Effective Collaboration:

- ✓ Leverage: Using each other to accelerate and support programs and projects of mutual interest
- ✓ Industry involvement in defining what engineering education should be to meet their needs and working with us to design a curriculum that would meet these needs
- ✓ Shared goals and visions, frequent communications, and shared rewards and credit for successes
- ✓ Building trust and honest partnership that results in job placements

Figure 8: Centers' Views of Most Important Elements for Effective Collaboration

Center Productivity in ATE Work Categories

The ATE program guidelines[13] indicate that the ATE centers should be comprehensive in scope, that is, the centers are intended to actively engage in the following programmatic activities (also see Figure 2, p. 5):

- ✓ Curriculum and educational materials development for national dissemination
- ✓ Professional development for educators
- ✓ Program improvement efforts
- ✓ Articulation between programs at two-year and four-year colleges

This section of the report examines the extent to which the ATE Centers are productive in these key activities and meeting the expectations of ATE as indicated in the ATE Program Solicitation (NSF-02-035).

Materials development

The ATE program guidelines indicate that materials development

> . . . activities should result in textbooks, laboratory experiments and manuals, software, CD-ROMs, videos, or other courseware that will be published for national distribution to colleges, secondary schools, or industry

Twelve of the 21 (57%) ATE centers responding to the 2004 ATE Survey reported engagement in materials development activities in the past 12 months. Table 12 summarizes materials development activities with regard to stages of development, materials distribution, target audiences, and media of the materials.

Overall, centers indicated development of 250 material items for courses, modules, and other purposes. Modules are the most frequently developed material, accounting for 60 percent of the total, with courses accounting for half that number (30%) and miscellaneous other items for the remaining 10 percent.

Figure 9 enhances the overall description of Table 12, showing that individual centers tend to focus on developing modules rather than developing all three types of materials. No center reported developing all types of materials, and less than half reported development of two types.

[13] Advanced Technological Education (2002). *Program Solicitation NSF-02-035*.

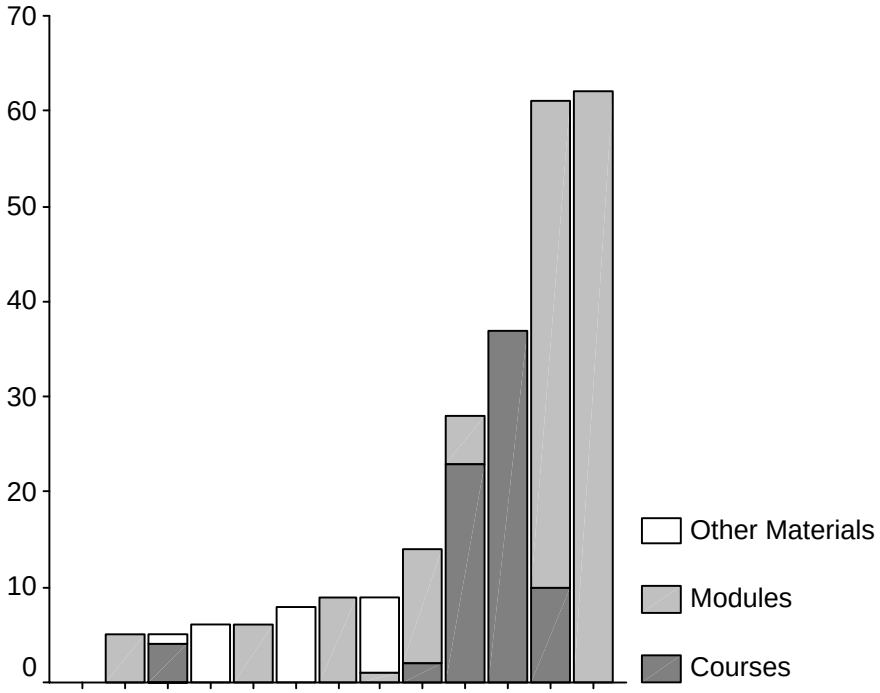


Figure 9: Foci of Center Developed Materials[14]

One striking characteristic of these materials is the media employed to present them. As Table 12 shows, many of the materials are not being produced as print or print only documents. Courses especially are being developed in other formats. Nearly three times as many course materials are being prepared for delivery via electronic means, CD-ROM and Internet, as are being produced for print distribution.

Centers principally target the associate degree level as the audience for course and module materials, especially courses. While baccalaureate and secondary levels receive less attention, a substantial proportion of modules are targeted toward the baccalaureate level; other materials tended to be evenly targeted across all three education levels.

Practices used by the ATE centers during development of materials were solicited on the premise that good development practices are likely to produce high quality materials. Three general practices were addressed:

- ✓ Assurance of content validity
- ✓ Testing of materials during development
- ✓ Measures to assess student success

The 12 ATE centers reported using industry standards or other guidelines in their development of materials. Such use is an important indicator of content validity. Nearly all state that in developing materials they always gathered input from business and

[14] The horizontal axis represents individual ATE Centers.

industry to assess workforce needs (*M* = 4.5, *SD* = 0.8) and use applicable student and industry standards or guidelines (*M* = 4.5, *SD* = 0.7). They also provide strong assurance of verifying alignment of materials with workforce needs (*M* = 4.2, *SD* = 1.1).[15]

Thirteen centers indicated that internal piloting and field-testing of materials were used most of the time (*M* = 4.3, *SD* = 0.9 and *M* = 4.2, *SD* = 1.2 respectively), while external field tests of materials were utilized approximately half the time (*M* = 3.3, *SD* = 1.5).[16]

As reported by 12 centers, measures to assess student success with industry standards (*M* = 2.3, *SD* = 1.1) and measures to assess improvement of student performance in the workforce (*M* = 2.2, *SD* = 1.3) were used less frequently. In particular, assessing student success with nonparticipating students was reported as seldom (*M* = 1.9, *SD* = 1.1).

Table 12 also shows that materials development work is reaching fruition with nearly half of the materials (courses, modules, and other) completed. The materials distribution portion of the table shows both the numbers of materials distributed and where they were distributed. Where courses tended to be distributed locally this past year, modules were more likely to be distributed nationally.

No center reported commercial publication of course materials, and only three centers reported commercial publication of modules or other materials. Centers do report using a variety of methods to disseminate their materials nationally. Predominant methods were center Web sites/Internet, conferences/workshops, professional publication, and word-of-mouth.

Moreover, 11 responding ATE centers indicated that 864 (*M* = 78.6, *SD* = 142.3) external institutions were using at least 1 center-developed material. Most of this external use is attributed to 1 center. Of the 864 institutions, 500 were reported by a single ATE Center, reducing the average to 36 institutions per center for the 10 other centers.

Finally, centers were asked to indicate the degree to which they are achieving the goal of national dissemination of their developed materials. Respondents indicated they view their centers as successful in achieving this goal[17] (*M* = 3.6, *SD* = 1.2).

[15] From 1 = never used to 5 = used each time.
[16] From 1 = never used to 5 = used each time.
[17] From 1 = not successful to 5 = highly successful.

Table 12: Center Materials

	Course					Module					Other Materials				
	N	**%**	***M***	***SD***	**Total**	***N***	**%**	***M***	***SD***	**Total**	***N***	**%**	***M***	***SD***	**Total**
Material Development Stage															
Draft Stage	4	33%	3.3	1.7	13	5	42%	9.2	15.0	46	3	25%	2.3	1.5	7
Field Tested	4	33%	7.5	10.0	30	5	42%	3.8	3.6	19	1	8%	6.0	0.0	6
Complete	4	33%	8.2	4.0	33	8	67%	10.8	16.9	86	2	17%	5.0	1.4	10
Material Distribution															
Local use	3	25%	14.3	19.7	43	4	33%	12.3	15.2	49	3	25%	5.3	1.2	16
Elsewhere	2	17%	5.0	1.4	10	6	50%	51.3	87.9	308	2	17%	6.0	0.0	12
Com. Publ.[18]	0	0%	0.0	0.0	0	1	8%	227.0	0.0	227	2	17%	3.0	1.4	6
Number Distributed	5	42%	76.0	71.2	380	6	50%	268.7	369.2	1,612	2	17%	4,574.5	4,844.4	9,149
Target Audiences															
Secondary	2	17%	2.5	2.1	5	4	33%	5.0	4.8	20	3	25%	6.0	2.0	18
Associate	5	42%	10.4	15.0	52	8	67%	14.8	20.9	118	4	33%	4.8	2.9	19
Baccalaureate	1	8%	3.0	0.0	3	5	42%	16.2	26.0	81	3	25%	4.7	3.1	14
Other[19]	0	0%	0.0	0.0	0	1	8%	2.0	0.0	2	0	0%	0.0	0.0	0
Instructional Media of Materials															
Print	3	25%	11.7	17.6	35	1	8%	62	0.0	62	3	25%	3.0	1.7	9
Audio/ Video	0	0%	0.0	0.0	0	0	0%	0.0	0.0	0	1	8%	1.0	0.0	1
CD-Rom	2	17%	10.5	13.4	21	0	0%	0.0	0.0	0	2	17%	3.5	3.5	7
Online	3	25%	22.7	34.1	68	2	17%	1.5	0.7	3	1	8%	8.0	0.0	8
Mixed Media	1	8%	1.0	0.0	1	1	8%	9.0	0.0	9	1	8%	1.0	0.0	1
Other	3	25%	6.3	3.2	19	2	17%	31.5	27.6	63	0	0%	0.0	0.0	0

Note. *N* = 12.

Professional development

Professional development is described by NSF[20] as

> Providing current secondary school teachers and college faculty with opportunities for continued growth in areas that directly impact advanced technological education . . . should be designed to enhance the educator's disciplinary capabilities, teaching skills, vitality, and understanding of current technologies and practices.

Seventeen of the 21 (81%) responding ATE centers reported engaging in various professional development activities. These centers conducted large numbers of professional development activities for faculty and staff members engaged in technological education at the secondary, associate, and baccalaureate levels. In sum,

[18] Commercially Published
[19] Other types of materials developed by centers included “K-8” and “a toolkit for IT curriculum development”, for example.
[20] Advanced Technological Education (2002). *Program Solicitation NSF-02-035*.

a total of 700 (from short-term events to long-term programs) opportunities for professional development were offered by ATE centers in the previous 12 months (see Table 13).

Table 13: Number of Professional Development Opportunities for Centers

Opportunities for Professional Development	Total	*M*	*SD*	*N*	%
Events	477	26.5	53.1	17	100%
Events with Follow-Up Activities	42	4.2	3.1	10	59%
Long-Term Programs	37	4.6	3.5	8	47%
Internships	26	4.3	4.4	6	35%
Self-Study Programs	115	38.3	53.6	3	18%
Other	3	1.5	0.7	2	12%

Note. *N* = 17.

A total of 10,502 participants from the secondary, associate, and baccalaureate levels attended center professional development activities. Events and events with follow-up activities comprised the largest proportion of center professional development (see Table 14). These activities extensively engage the secondary and associate levels. Only self-study programs at the baccalaureate level are relatively proportional to those of the secondary and associate levels. As both tables 13 and 14 show, most centers conducted professional development events and events with follow-up. Fewer engaged in longer term programs. Across all three educational levels, most participants were from a single ATE center (see Figure 10).

Table 14: Center's Professional Development Participants Across Education Levels

Opportunity	Educational Level	Total	*M*	*SD*	*N*	%
Events	Secondary	1,260	78.8	127.0	16	94%
	Associate	2,538	149.3	178.9	17	100%
	Baccalaureate	976	75.1	186.2	13	76%
Events with Follow-Up Activities	Secondary	2,338	292.3	767.0	8	47%
	Associate	2,002	200.2	492.9	10	59%
	Baccalaureate	665	95.0	233.4	7	41%
Long-Term Programs	Secondary	71	23.7	29.0	3	18%
	Associate	108	15.4	16.8	7	41%
	Baccalaureate	32	10.7	15.0	3	18%
Internships	Secondary	2	2.0	0.0	1	6%
	Associate	96	19.2	33.1	5	29%
	Baccalaureate	9	2.3	2.5	4	24%
Self-Study Programs	Secondary	70	70.0	0.0	1	6%
	Associate	146	48.7	62.2	3	18%
	Baccalaureate	130	65.0	77.8	2	12%
Other	Secondary	53	26.5	33.2	2	12%
	Associate	2	2.0	0.0	1	6%
	Baccalaureate	4	4.0	0.0	1	6%

Note. *N* = 17.

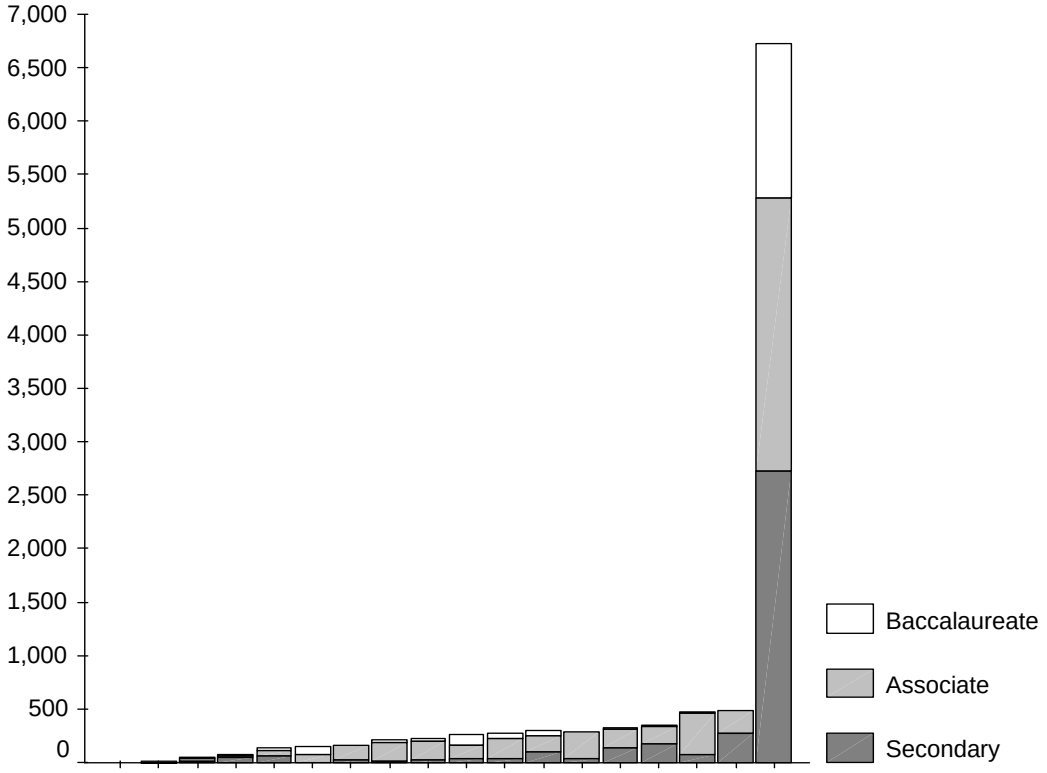


Figure 10: Total Professional Development Participants Across Education Levels[21]

An important aspect of centers' productivity related to professional development goes beyond provision of training to implementation of lessons learned. That is, in order for professional development activities to be successful, these endeavors must be implemented and integrated into the educational environment. To address this matter each respondent was asked to report "the percentage of participants that, based on evidence you collected, reported each level of outcome." Three levels were provided for their response (see Table 15).

Three patterns emerged from the data. First, percentage values for "intent to use" are consistently much higher than those for the category "tried or implemented." In turn, tried or implemented percentages are higher than percentage of centers that "found gains in student achievement." These findings are in line with what would be expected generally from professional development efforts. That is, that intent to implement is greater than actual implementation which, in turn, is greater than established gains when implementation occurs.

Second, the respondent *n*'s get smaller in the transition from intent to tried to achievement gain. This reduction in *n*'s suggests that centers generally gather more evidence at the event or initial stages than occurs when implementation is in process.

[21] The horizontal axis represents individual ATE Centers.

That perception regarding the *n*'s pattern is buttressed by other data on follow-up. All of the ATE centers engaged in professional development activities indicated that they conducted at least one method of follow-up on their professional development participants. Most commonly the form of follow-up[22] used was end-of-program reaction data (*M* = 4.8, *SD* = 0.4) and, to a somewhat lesser extent, data to determine implementation (*M* = 3.9, *SD* = 1.2). Fewer centers collected data to determine the extent of impact on student achievement due to professional development activities (*M* = 2.9, *SD* = 1.6).

Third, the number of centers engaged in professional development activities is much greater for short-term activities (i.e., events, and events with follow-up activities) than for longer term ones.

The three trends together[23] suggest that most professional development activities are limited to what can be transmitted at events (e.g., awareness of new materials) rather than more in-depth information that can be studied and learned over extended periods of time. While there is substantial immediate feedback about viability (e.g., intention of implementation), there is much less direct engagement in long-term implementation and gathering of information to assess impact of implantation.

[22] From 1 = never collected to 5 = always collected.
[23] This does not include "other" types of professional development activities.

Table 15: Center Utilization and Outcomes of Professional Development Activities

Opportunity	Utilization an Outcomes	*N*	%	*M*	*SD*
Events	Intent to Use Information	16	94%	89.4%	13.5%
	Tried or Implemented New Materials or Ideas	9	53%	77.2%	15.4%
	Student Achievement Increased Due to Implementation	6	35%	60.0%	24.5%
Events With Follow-Up Activities	Intent to Use Information	11	65%	93.0%	8.3%
	Tried or Implemented New Materials or Ideas	9	53%	77.0%	25.9%
	Student Achievement Increased Due to Implementation	6	35%	71.7%	24.0%
Long-Term Programs	Intent to Use Information	6	35%	80.8%	18.6%
	Tried or Implemented New Materials or Ideas	6	35%	73.3%	16.0%
	Student Achievement Increased Due to Implementation	3	18%	63.3%	23.1%
Internships	Intent to Use Information	6	35%	86.7%	21.6%
	Tried or Implemented New Materials or Ideas	4	24%	71.3%	33.8%
	Student Achievement Increased Due to Implementation	2	12%	95.0%	7.1%
Self-Study Programs	Intent to Use Information	1	6%	90.0%	0.0%
	Tried or Implemented New Materials or Ideas	1	6%	75.0%	0.0%
	Student Achievement Increased Due to Implementation	1	6%	50.0%	0.0%
Other	Intent to Use Information	2	12%	100.0%	0.0%
	Tried or Implemented New Materials or Ideas	1	6%	70.0%	0.0%
	Student Achievement Increased Due to Implementation	0	0%	0.0%	0.0%

Note. *N* = 17.

Overall, the ATE centers reported that they are, in fact, achieving their professional development goals. The large majority of responding centers (i.e., 80% or greater) rate themselves as successful or highly successful on four variables: enhancing disciplinary skills (*M* = 4.3, *SD* = 0.8), enhancing educator teaching skills (*M* = 4.3, *SD* = 0.7), enhancing usage of educational technologies (*M* = 4.0, *SD* = 0.7), and enhancing understanding of current technologies and practices (*M* = 4.4, *SD* = 0.7).[24]

[24] From 1 = not successful to 5 = highly successful.

Centers were asked to support their claims for effects: “describe the evidence available to support your responses regarding the degree to which your project/center/partnership is achieving professional development goals.” Figure 11 provides representative statements to support these claims.

Evidence to support achievement of professional development goals:

- ✓ Our ATE project has trained well over 850 IT faculty since our inception- our original goal at this time was to have trained 380.
- ✓ The number of faculty with one or more IT certifications/advanced degrees increased by 73 percent this year.
- ✓ Pre and post assessment process and follow up assessment
- ✓ "Workshop evaluation data that self reports enhancement of knowledge and program applicability

Figure 11: Evidence Supporting Achievement of Professional Development Goals

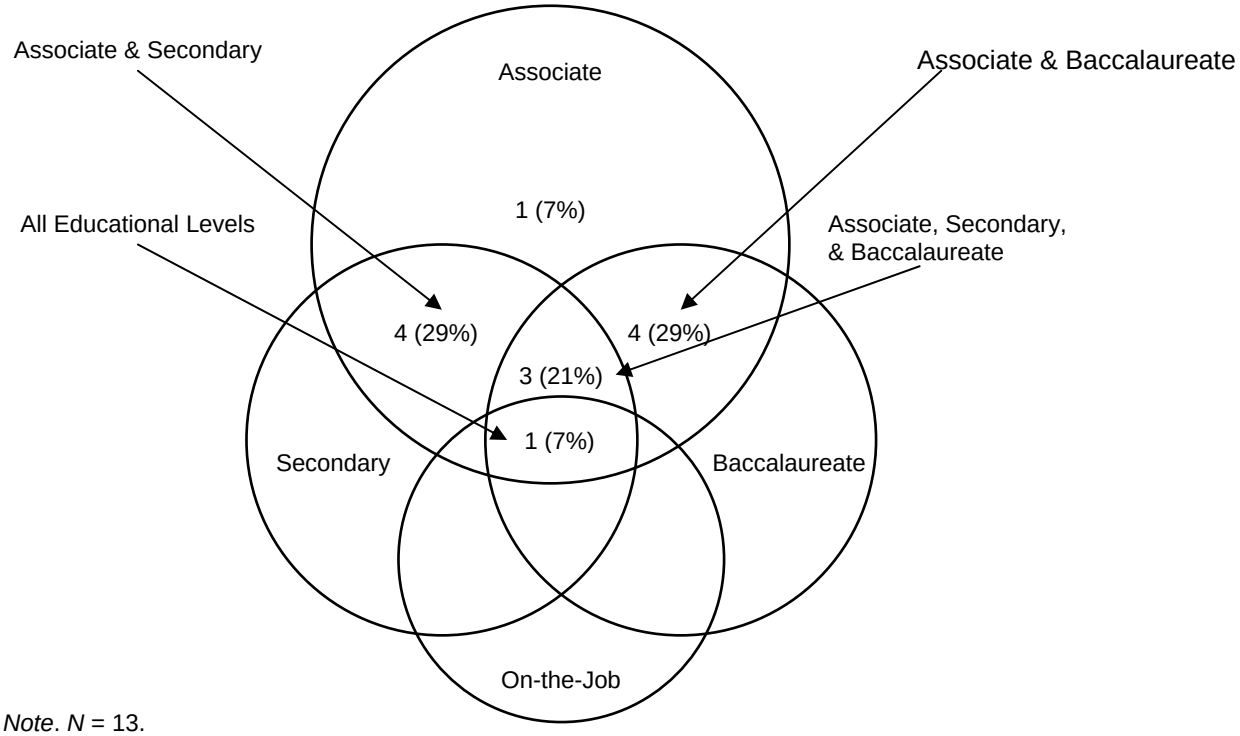
As the above suggests, professional development activities and information predominately address intent rather than outcomes. These "evidence" statements focus on numbers of participants involved in professional development processes rather than proof of quality, the exception being the pre-post assessment statement. This, though, deals with learning rather than implementation and effectiveness of the implementation.

Program improvement

Program improvement encompasses the ATE centers' efforts to construct new programs and courses and modify existing courses, as well as student recruitment, retention, and placement efforts. Fifteen of the 21 (71%) ATE centers indicated that they engaged in program improvement efforts; 13 centers provided data on program enrollments. These data provide indicators of program improvement impact and focus on the following information:

- ✓ Programs, locations, courses, and students at the secondary, associate, and baccalaureate levels, and on-the-job training
- ✓ Student status
- ✓ Program model representation
- ✓ Dissemination of program

As Figure 12 shows the programmatic level involvement for 13 centers. All work with associate degree students. Only one works exclusively with associate degree students; and four work with three or more education levels. Those combinations not represented (e.g., secondary and on-the-job) had no ATE centers involved in improving their programs in these combinations.



Note. *N* = 13.

Figure 12: Combinations of Center Program Improvement Efforts[25]

These ATE centers reported that 284 ATE-funded programs were offered or developed across 501 locations. These programs consisted of 722 unique courses and were attended by more than 27,000 students who have taken at least 1 course in the past 12 months; the majority of these students were associated with 2 centers (see Figure 13). As the figure also shows, most students were engaged at associate degree institutions. Table 16 provides a more complete breakdown, confirming that the largest number of programs, locations, and courses also occurred at the associate level followed by the secondary level. These centers reported more than 11,000 students in each of the categories of applicant, accepted, and newly enrolled in the past 12 months (see Table 17).

In terms of program enrollment, centers reported a total of 23,480 students enrolled in their programs across all education levels (see Table 18). These enrollment patterns follow the same trends noted for those taking at least 1 course. Coupled to these program enrollment data, are several facets or facts:

- The faces of program participants change substantially from year to year. When annual program graduates and dropouts are accounted for, approximately 40 percent (9,000 students) are expected to return to the program in the following year (see Table 20).
- Four centers work with baccalaureate programs engaging an average of 25 students each.

[25] Based on ATE center reported student enrollment.

- The center programs focus principally on training new technicians rather than on updating technician skills.
  - Only 1 center provided a program oriented to on-the-job training, and it enrolled 40 students (see Table 18).
  - The centers work primarily with students who do not have experience as technician employees. About one-eighth of the students (2,900) were employed as technicians prior to enrollment in center programs (see Table 19).

The Student Impact section of this report provides additional data on the ATE Center's students.

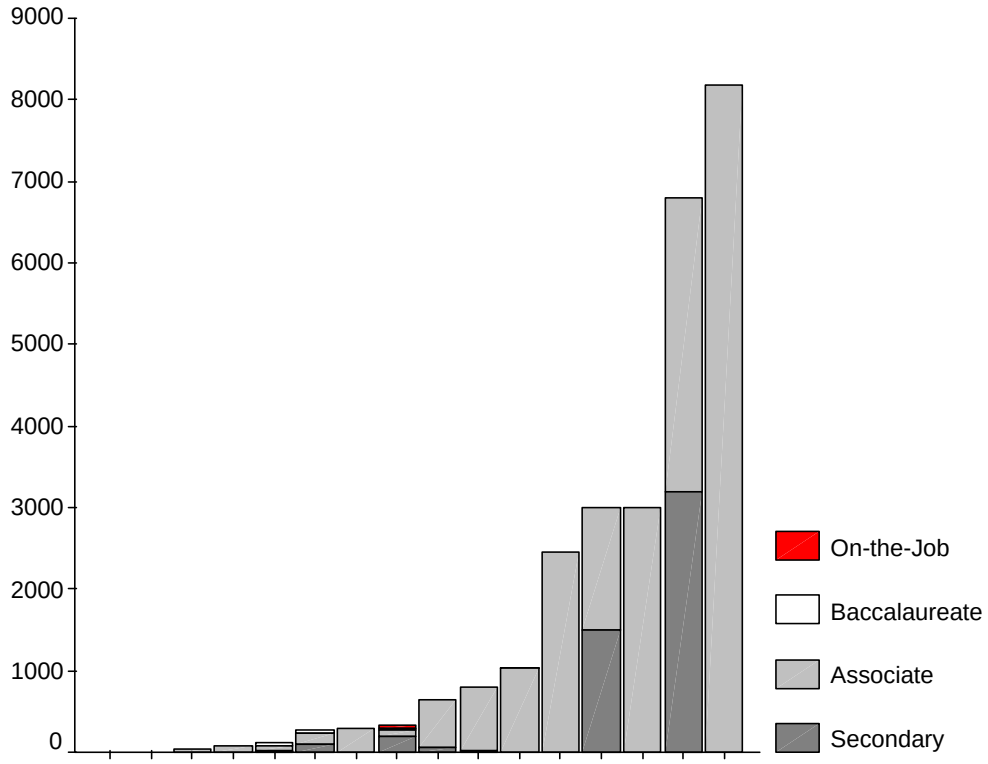


Figure 13: Student Who Have Taken at Least 1 Center Course in the Past 12 Months[26]/[27]

[26] The horizontal axis represents individual ATE Centers.
[27] Unique students who have taken at least one course in the ATE-funded program in the past 12 months.

Table 16: Number of Center Programs, Locations, Courses, and Students Across Educational Levels

	Total	***M***	***SD***	***N***	**%**
Number of ATE-Funded Programs Developed/ Offered					
Secondary	101	12.6	27.3	8	53%
Associate	162	10.8	17.8	15	100%
Baccalaureate	10	2.0	1.0	5	33%
On-the-Job	11	2.8	3.5	4	27%
Number of Locations Where ATE-Funded Programs Offered					
Secondary	274	39.1	42.9	7	47%
Associate	185	13.2	13.6	14	93%
Baccalaureate	10	2.5	1.0	4	27%
On-the-Job	32	16.0	5.7	2	13%
Number of Unique Courses Offered Across ATE-Funded Programs					
Secondary	118	19.7	39.5	6	40%
Associate	587	41.9	46.2	14	93%
Baccalaureate	15	3.8	2.9	4	27%
On-the-Job	2	1.0	0.0	2	13%
Number of Unique Students Who Have Taken at Least 1 ATE-Funded Course in the Past 12 Months					
Secondary	5,095	727.9	1,213.5	7	47%
Associate	21,820	1,558.6	2,241.1	14	93%
Baccalaureate	101	25.2	15.9	4	27%
On-the-Job	40	40.0	0.0	1	7%

Note. *N* = 15.

Table 17: Number of Center Applicants, Acceptances, and Newly Enrolled Students in the Past 12 Months

	Total	*M*	*SD*	*N*	%
Number of Applicants in the Past 12 Months					
Secondary	353	117.7	73.9	3	20%
Associate	10,810	1,801.7	3,199.2	6	40%
Baccalaureate	15	7.5	3.5	2	13%
Number of Students Accepted in the Past 12 Months					
Secondary	413	103.3	73.9	4	27%
Associate	11,469	1,638.4	2,952.6	7	47%
Baccalaureate	15	7.5	3.5	2	13%
Number of Newly Enrolled Students in the Past 12 Months					
Secondary	413	103.3	73.9	4	27%
Associate	11,269	1,609.9	2,951.8	7	47%
Baccalaureate	15	7.5	3.5	2	13%

Note. *N* = 15.

Table 18: Students Enrolled in Center Programs Across Education Levels

	Total	*M*	*SD*	*N*	%
Number of Enrolled Students					
Secondary	1,317	329.3	453.2	4	27%
Associate	22,022	1,694.0	2,318.6	13	87%
Baccalaureate	101	25.3	15.9	4	27%
On-the-Job	40	40.0	0.0	1	7%

Note. *N* = 15.

Table 19: Center Students Employed as Technicians Prior to Enrollment

	Total	*M*	*SD*	*N*	%
Employed as Technician Prior to Enrollment					
Secondary	0	0.0	0.0	0	0%
Associate	2,860	408.6	747.8	7	47%
Baccalaureate	0	0.0	0.0	0	0%
On-the-Job	40	40.0	0.0	1	7%

Note. *N* = 15.

Table 20: Students Remaining in Center Programs

	Total	*M*	*SD*	*N*	%
Students Remaining in Program					
Secondary	0	0.0	0.0	0	0%
Associate	9,020	1,503.3	2,351.2	6	40%
Baccalaureate	10	10.0	0.0	1	7%
On-the-Job	0	0.0	0.0	0	0%

Note. *N* = 15.

The ATE centers are intended to act as "comprehensive national or regional resources that provide models and leadership for other projects."[28] Respondents report that they are successful in creating models for program improvement[29] (*M* = 4.3, *SD* = 0.9) and that they were successfully[30] disseminating their programs (*M* = 3.9, *SD* = 0.9). Overall, the ATE centers are achieving these two overarching program improvement goals. Additional evidence provided by centers to support claims of achieving these goals is summarized in Figure 14.

Evidence to support achievement of professional development goals:

- ✓ Increased enrollment—our program realized full enrollment this year, the first full enrollment in six years
- ✓ High employment level after graduation—overall employment of 2003 graduates is approximately 80%
- ✓ Many outside institutions have shown an interest in our program.
- ✓ Industry survey of graduates—we have compared our graduates with other students at the college
- ✓ External evaluator feedback & reports
- ✓ Increased enrollments in programs and other schools looking to adopt materials, programs and courses

Figure 14: Evidence Supporting Success in Creating a Model for Program Improvement

Articulation between programs

Articulation agreements provide pathways for students to matriculate to a higher level of education and are typically collaborative efforts involving two-year colleges, four-year colleges and universities, and secondary schools. These collaborative articulation agreements enhance the ability of two-year college students to transfer to four-year programs, thus improving the quality of these students' preparation. This section of the

[28] Advanced Technological Education (2002). *Program Solicitation NSF-02-035*.
[29] From 1 = not successful to 5 = highly successful.
[30] From 1 = not successful to 5 = highly successful.

report addresses both articulation agreements for students preparing for careers as technicians as well as teacher preparation agreements. The ATE centers reported on their overall articulation activities as well as a single agreement that was in place.

Eleven of the 21 (52%) ATE centers reported engaging in articulation activities. These centers reported a total of 782 articulation agreements in place across 607 institutions (see Table 21). As this table shows, these agreements are most frequently reached between high schools and 2-year colleges, exceeding 2-4 year college agreements by a ratio of about 4:1.

Under these agreements a total of 1,120 students matriculated to higher level institutions in the past 12 months (see Table 22). The most productive agreements were between high schools and 2-year colleges. Under these agreements a total of 765 students matriculated in the past 12 months. Figure 15 illustrates the distribution of total center agreements, institutions, and the number of students who articulated under these agreements in the past 12 months. As can be seen in this figure two of the ATE Centers are highly productive in terms of agreements, institutions, and matriculating students to higher level institutions.

Table 21: Number of Center Articulation Agreements and Institutions Involved

	Total	***M***	***SD***	***N***	**%**
Number of Articulation Agreements					
High Schools to 2-Year Colleges	645	80.6	139.3	8	73%
2-Year to 4-Year Colleges	136	17.0	20.4	8	73%
Teacher Preparation—High Schools to 2-Year Colleges	1	1.0	0.0	1	9%
Number of Institutions Involved in Articulation Agreements					
High Schools to 2-Year Colleges	479	59.9	67.5	8	73%
2-Year to 4-Year Colleges	127	15.9	12.3	8	73%
Teacher Preparation—High Schools to 2-Year Colleges	1	1.0	0.0	1	9%

Note. *N* = 11.

Table 22: Number of Center Students Who Articulated in the Past 12 Months

	Total	***M***	***SD***	***N***	**%**
Number of Students Who Articulated					
High Schools to 2-Year Colleges	765	127.5	174.1	6	55%
2-Year to 4-Year Colleges	355	59.2	75.3	6	55%
Teacher Preparation—High Schools to 2-Year Colleges	0	0.0	0.0	0	0%

Note. *N* = 11.

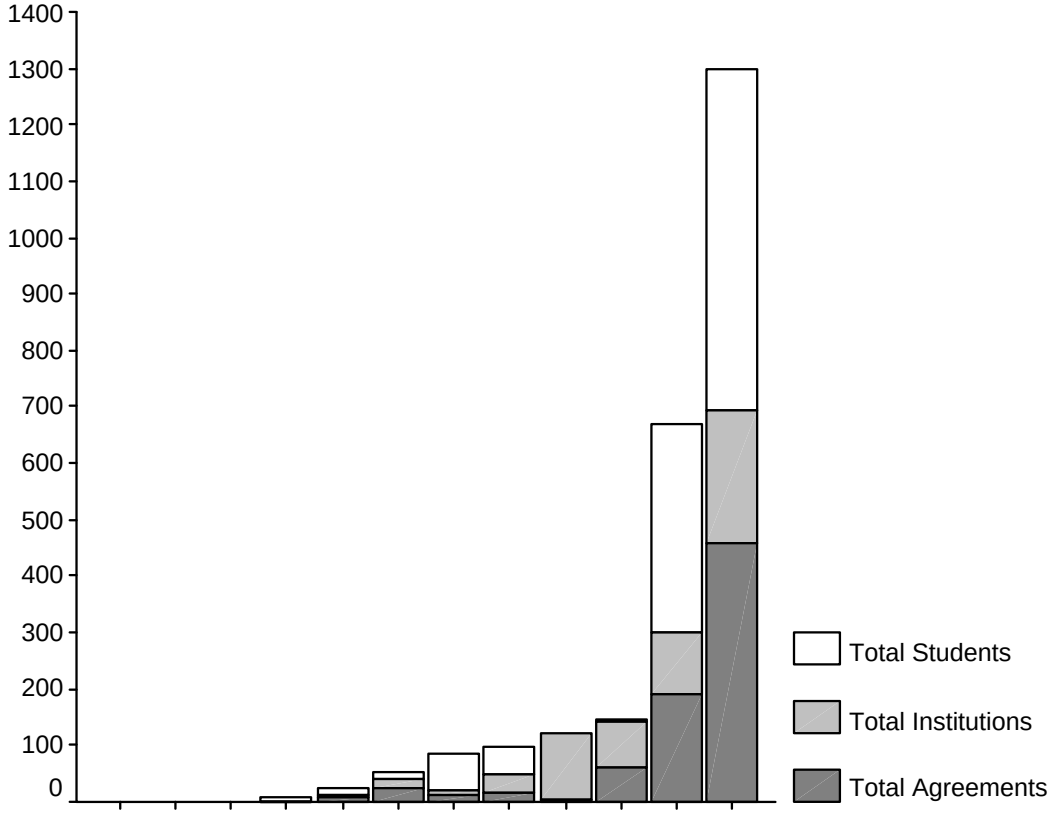


Figure 15: Total Agreements, Institutions, and Students Who Articulated[31]

One special type of articulation agreement—a teacher preparation agreement between a high school and two-year college—was reached at one center. That arrangement has yet to serve any students.

Under a single ATE center-specified articulation agreement,[32] the centers reported that a total of 30 institutions were involved and 24 students articulated (see Table 23). Of the 24 students who articulated in the past 12 months under center-specified agreements, the ratio of male (*N* = 16) to female (*N* = 8) students matriculating to higher-level education was 2:1 (see Table 24). Ten percent of these students were Hispanic/Latino, 2 percent were American Indian/Alaska Natives, 2 percent were Asian, 8 percent were Black/African American, 4 percent were multiracial, and the remaining 74 percent were White/Caucasian. Proportionally, White/Caucasian students outnumber all other students who articulated 3:1. Furthermore, under these specified agreements, 42 percent of responding centers indicated that some or all of the general education credits

[31] The horizontal axis represents individual ATE Centers.
[32] Centers were asked to provide information on one agreement and describe this agreement in detail.

for specific courses transferred; 75 percent reported that some or all of the technical education credits for specific courses transferred; 50 percent indicated that program completion allowed students to matriculate at selected institutions; and 58 percent reported that program completion allowed students to matriculate at selected institutions with standing (see Table 25). Overall, the ATE centers described the characteristics of their specified articulation agreements as depicted in Figure 16.

Characteristics of Specified Articulation Agreement

- ✓ Students are permitted to enter with junior class standing and transfer a maximum of 64 credit hours earned in the AAS degree.
- ✓ Transferring students receive an automatic 1/3 tuition reduction at the receiving institution.
- ✓ Students receive college credit for high school course.
- ✓ Students earn technical and general education credits toward the community college degree while in high school.
- ✓ Students benefit by shortening their time to obtain workforce skills.

Figure 16: Characteristics of Specified Articulation Agreement

Table 23: Number of Institutions and Students Articulating for One Specified Agreement

	Total	***M***	***SD***	***N***	**%**
Number of Institutions Involved in Specified Agreements	30	3.3	4.8	9	82%
Number of Students Who Articulated Under Specified Agreement	24	4.0	2.2	6	55%

Note. *N* = 11.

Table 24: Gender and Racial/Ethnic Composition of Students Who Articulated in Past 12 Months

	Total	***M***	***SD***	***N***	**%**
Male	16	3.2	1.6	5	45%
Female	8	2.0	1.4	4	36%
Hispanic/Latino	5	5.0	0.0	1	9%
American Indian/Alaska Native	1	1.0	0.0	1	9%
Asian	1	1.0	0.0	1	9%
Black/African American	4	4.0	0.0	1	9%
Multiracial	2	2.0	0.0	1	9%
White/Caucasian	39	6.5	6.0	6	55%

Note. *N* = 11.

Table 25: Articulation Agreement Characteristics

	N	**%**
Some or all of the general education credits for specific courses transfer	5	45%
Some or all of the technical education credits for specific courses transfer	9	82%
Program completion allows students to matriculate at selected institutions	6	55%
Program completion allows students to matriculate at selected institutions with standing	7	64%

Note. *N* = 11.

Center Impact on Students

The overarching goal of the ATE program is to increase the number and quality of technicians in the United States and, as a result, positively impact the workforce in technological disciplines. Previous sections of this report have focused on ATE's work to improve the quality of instruction for technician programs through collaborations, materials development, professional development of faculty, and improvements and increased dissemination of improved instructional programs.

Here attention is given to outcomes of these programs. Specifically, this section attends to the question, "To what extent do students complete these programs and/or enter the technician fields?" The ATE program's objectives include not just contributions to the technician workforce, but increasing the numbers of female and minority students trained in technology fields as well.

Responses from 15 centers to questions about student instructional programs indicate that more than 20,000 students participated in these programs during the past year[33] (see Table 26). Of this number

- Roughly 20 percent (4,000) of the ATE students completed an ATE-based program during the past year. These completers were highly likely to join the technician workforce or continue STEM education—83 percent either were employed as technicians or continued their STEM education.
- Even among those who left an ATE program prior to completion (2,800), a majority (53%) were thought to take employment in technician positions or continue STEM education.

Enrollment data provide the following general demographic results for sex and ethnicity:

- Approximately one-third of program participants are female (31%).
- Slightly more than a quarter (28%) of these ATE students are minorities.

By projecting from these attendance data to completion and employment findings, we estimate that approximately 1,200 women and 1,100 minorities annually complete an ATE program with 83 percent (1,000 and 900 respectively) taking positions as technicians or continuing their STEM education. Similarly, of the women and minorities who did not complete a full ATE program, an estimated 53 percent (460 women and 400 minorities) are either employed as technicians or continuing their STEM education.

These figures are comparable to previous years (c.f., Survey 2003: ATE Program Status and Trends[34]), though there was a slight drop in female enrollment (from 35% in 2003 to 31% in 2004). Women continue to be engaged in technological programs at much lower rates than other community college programs. Nationally, almost 60 percent

[33] Tabular results vary depending upon whether the questions regard numbers enrolled or characteristics of students (e.g., ethnicity and sex). All, however, indicate enrollments are 20,000 or higher.
[34] Available at http://www.wmich.edu/evalctr/ate/2003_ATE_Evaluation_SurveyReport.pdf

of community college students are female (Kent, 2000).[35] However, as other data show, the proportion of women engaged in these technological education programs is roughly equal to the proportion of women nationally who obtain degrees in science and engineering versus other degrees (http://www7.nationalacademies.org/cwse/).

Minorities, however, are participating in ATE programs in close proportion to their attendance in associate degree institutions[36] (Kent, 2000), as illustrated in Table 27. Centers report very few requests for accommodations for disabilities (1 person per 1,000 students).

On an annual average basis, each center has provided instruction for approximately 300 persons (93 female and 84 minorities) who are currently in the technician workforce or continuing their study within STEM disciplines. Not measured by this survey are the numbers of students whose instruction has been impacted through improved materials developed or professional development for faculty offered by these or other ATE centers.

Table 26: Gender Demographics of Center-Enrolled Students

	Total	***M***	***SD***	***N***	**%**
Male Students Enrolled					
Secondary	1,781	593.7	927.9	3	20%
Associate	13,250	1,325.0	1,834.2	10	67%
Baccalaureate	7	7.0	0.0	1	7%
On-the-Job	35	35.0	0.0	1	7%
Female Students Enrolled					
Secondary	1,639	546.3	858.4	3	20%
Associate	5,114	511.4	762.8	10	67%
Baccalaureate	3	3	0.0	1	7%
On-the-Job	5	5	0.0	1	7%

Note. *N* = 15.

[35] Kent, A. P. (2000). Community college fall headcount enrollment by age and gender. In M. Patton (Ed.), *National profile of community colleges: Trends and statistics* (3rd ed.). Washington, DC: Community College Press.

[36] Centers were asked to report the number of students who requested accommodations for disabilities. Responses indicated that 20 students requested accommodations at the associate level (*N* = 3, *M* = 6.7, *SD* = 5.0). No requests were reported at any other educational level.

Table 27: Racial/Ethnic Composition of Center-Enrolled Students

	Total	*M*	*SD*	*N*	%
Hispanic/Latino					
Secondary	372	186.0	234.8	2	13%
Associate	1,912	191.2	249.2	10	67%
American Indian/Alaska Native					
Secondary	32	32.0	0.0	1	7%
Associate	193	21.4	34.2	9	60%
Asian					
Secondary	64	64.0	0.0	1	7%
Associate	794	99.3	142.7	8	53%
Black/African American					
Secondary	499	166.3	219.6	3	20%
Associate	1,923	174.8	200.3	11	73%
Baccalaureate	2	2.0	0.0	1	7%
On-the-Job	2	2.0	0.0	1	7%
Native Hawaiian/Pacific Islander					
Associate	38	12.7	15.1	3	20%
Multiracial					
Secondary	98	98.0	0.0	1	7%
Associate	601	120.2	110.1	5	33%
White/Caucasian					
Secondary	2,255	1,127.5	1,570.5	2	13%
Associate	14,390	1,599.0	2,302.5	9	60%

Note. *N* = 15.

To determine if centers positively impact the United States' workforce through an increase in the number of technicians, centers were also asked to report on the number of students who completed their programs during the last 12 months as well as the number of students who left programs prior to completion. Moreover, centers were to identify the number of students who started or continued working as technicians and the number of students who started or continued STEM education after the completion of a program and after having left a program without its completion. Sixteen centers provided information in response to these questions and the results are displayed in Table 28.

Table 28: Center Students Who Completed and Left Programs

	Students Who Completed Program					Students Who Left Program Prior to Completion				
	N	**%**	***M***	***SD***	**Total**	***N***	**%**	***M***	***SD***	**Total**
Secondary	2	13%	110.0	127.3	220	0	0%	0.0	0.0	0
Associate	8	53%	515.5	500.3	4,124	5	33%	556.8	847.7	2,784
Baccalaureate	1	7%	20.0	0.0	20	0	0%	0.0	0.0	0
On-the-Job	1	7%	40.0	0.0	40	0	0%	0.0	0.0	0
Started/Continued Employment as Technician										
Secondary	0	0%	0.0	0.0	0	0	0%	0.0	0.0	0
Associate	7	47%	313.1	358.8	2,192	4	27%	333.8	465.8	1,335
Baccalaureate	1	7%	4.0	0.0	4	0	0%	0.0	0.0	0
On-the-Job	0	0%	0.0	0.0	0	0	0%	0.0	0.0	0
Started/Continued STEM										
Secondary	3	20%	105.0	92.6	315	0	0%	0.0	0.0	0
Associate	5	33%	170.4	242.3	852	2	13%	72.0	96.2	144
Baccalaureate	2	13%	7.0	4.2	14	0	0%	0.0	0.0	0
On-the-Job	1	7%	40.0	40.0	40	0	0%	0.0	0.0	0

Note. *N* = 15.

As Table 28 shows, 12 centers reported that 4,404 students completed their programs in the past 12 months across various education levels. Data on program dropouts is much less complete. Five centers indicated that 2,784 students left their programs at the associate level prior to completion. Of program graduates, 2,196 reportedly started or continued employment as technicians, and 1,221 graduates started or continued STEM education. Of the 2,784 students who left their program prior to completion, 1,335 started or continued employment as technicians and 144 started or continued STEM education. As Figure 17 illustrates, 83 percent (3,674 of 4,404) of these completions were the result of 4 center programs.

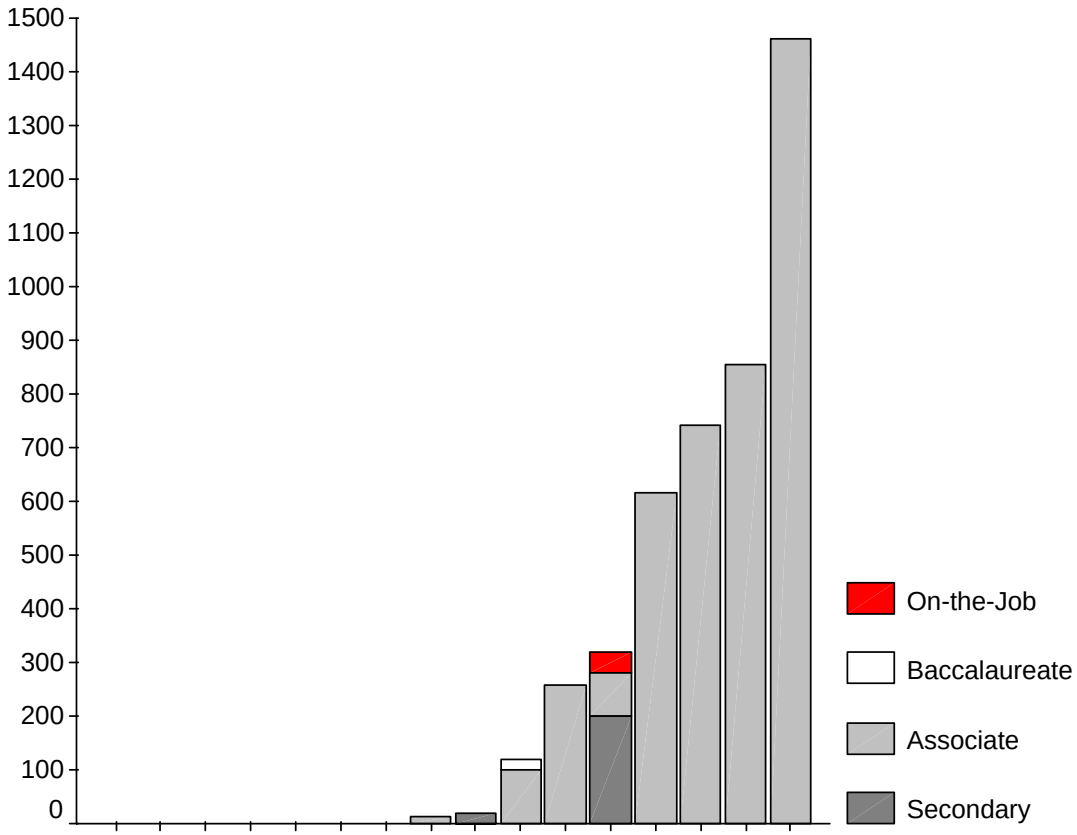


Figure 17: Students Who Completed Center Programs[37]

[37] The horizontal axis represents individual ATE Centers.

Conclusions and Recommendations

Our analysis was intended to address each of the following questions pertaining to various aspects of the ATE centers.

What is the Size and Scope of Work for ATE Centers?

The size and scope of work for ATE centers varies greatly. Although the centers are widely distributed across the United States (see Figure 1, p. 3), most do not engage in the full range of ATE activities. For example, only 38 percent are actively developing materials for national dissemination, providing professional development for teachers, improving their programs, and partnering with other institutions to assist students in matriculating to higher levels of education. The other 62 percent are engaged in 3 or fewer of these activities, although program guidelines stipulate that centers comprehensively engage in the full range of activities. A total of 4,404 students completed center programs, 2,192 center students started or continued employment as technicians, and 1,221 center students started or continued STEM education.

To What Degree do ATE Centers Apply Rigorous Internal Practices in Their Operations?

Four indicators were used to assess the rigor of the ATE centers' internal practices: (1) use of advisory committees, (2) workforce needs assessment, (3) evaluation, and (4) monitoring. Most centers have national advisory committees (85%), half have conducted workforce needs assessments within the past 12 months, 85 percent employ either internal or external evaluators, and all engage in one or more types (e.g., site visits to/from NSF, e-mail) of interactions with NSF. Although the ATE Centers are actively engaged in these elements of operation, expenditures for these activities are below the generally accepted norm. For example, they spent slightly more than $7,000 per center on advisory committee activities and approximately 5 percent of their ATE awards on evaluation.

How Extensive are ATE Center Collaborations?

Seventy-six percent of ATE centers collaborate with other ATE-funded *projects* (a total of 106 collaborative arrangements); one-fourth received monetary support, and more than half received in-kind support. These collaborative arrangements with other ATE grantees served 4 predominant purposes: general support, materials development for national dissemination, professional development for educators, and improvement of programs. All centers collaborate with non-ATE institutions such as business and industry, their host institution, public agencies, and other organizations. These collaborative agreements serve a number of program-related purposes, including monetary and in-kind support, as well as general program support, development of materials, professional development for educators, improving center programs, and articulation, among others. Overall, the ATE centers received a combined total of $15,328,080 in monetary and in-kind assistance from collaborative partners.

How Productive are ATE Centers in Terms of the Primary ATE Work Categories?

Taken as a whole the ATE centers are producing vast quantities of materials, providing professional development opportunities for educators, developing programs across numerous locations and education levels, serving students, and providing students pathways to higher level technological education. Fifty-seven percent of centers engage in developing materials for national dissemination. These centers produced 250 material items for courses, modules, and other purposes. Eighty-one percent of centers engage in various professional development activities. A total of 10,502 participants attended 700 center-sponsored events in the past 12 months. Seventy-one percent of centers are constructing new programs and courses and are engaged in student recruitment, retention, and placement efforts at the secondary, associate, and baccalaureate levels and on-the-job training. Two-hundred eighty-four programs were offered or developed across 501 locations and consisted of 722 courses, which were attended by more than 27,000 students. Fifty-two percent of centers engage in articulation agreements. Under 782 agreements across 607 institutions, 1,120 students matriculated to higher level institutions.

What Impact are ATE Centers Having on Students?

Large numbers of students are completing center programs and continuing/starting employment as technicians or continuing/starting STEM education. In the past year 4,000 students completed an ATE-based program of study. A majority (83%) of completing students either were employed as technicians or continuing STEM education. Overall, the number of students completing center programs outnumbers those who fail to complete (drop out) by an almost 2:1 ratio. Slightly more than one-third of ATE-program students are female, and more than one-fourth are minority.

Overall Assessment

The ATE centers perform well in *setting the stage*; that is, ATE-funded centers are consistent with the program's federal mandate. The centers are comprehensive in scope and are engaging in multiple ATE work-related activities that emphasize a wide range of technological disciplines. This in turn leads to the application of sound organizational practices. These practices include employing advisory committees and evaluative efforts, as well as assessing workforce needs, for example. Moreover, strong cooperative efforts between the ATE centers and other institutions and organizations are occurring. Thus, the ATE centers are *setting the stage* for success.

In each of the four *program elements*—primary categories of work—a small number of ATE centers are excelling. By and large, single centers are highly productive in one or more of the work categories, inflating overall numbers (e.g., of the 10,000 professional development participants, almost 7,000 were from a single ATE center). This occurred across all four categories of work (materials development, professional development, program improvement, and articulation agreements). Single, highly productive centers contribute substantially greater efforts and outcomes than the combined efforts of the others.

The ATE centers' achievement of *program goals*—to increase the number and quality of technicians in the United States and, as a result, positively impact the workforce in technological disciplines—is occurring, since the ATE centers are serving a large number of students. Yet, female students enrolling in and completing center programs have declined from 2003 to 2004 (from 35% to 31%). Minority enrollment in ATE Center programs is comparable to national enrollment rates.

Recommendations

1. *Encourage the ATE centers to engage in programming in each of the 4 primary ATE work categories*. Evidence shows that this is not the case; only 38 percent of centers engage in all 4 work categories. Given the expectations that ATE centers provide comprehensive programming and the levels of funding that they receive, they are best positioned within the ATE program to integrate materials development, professional development, program improvement, and student articulation.

2. *Encourage the ATE centers to directly leverage the work of other ATE grantees and integrate this work into their programming*. Centers have a strong network of ATE collaborations that can be leveraged for these purposes. To promote comprehensive programming by individual centers, they can collaborate with specific ATE projects that may be more directly focused in one area (e.g., professional development) and then adapt and implement project programs at the center level.

3. *Encourage the ATE centers to increase advisory panel and evaluation expenditures*. Centers spend less than the NSF-recommended 5 percent on evaluation and less than $7,000 per center annually for advisory panels. Increasing the investment in evaluation can help provide some of the hard evidence that is lacking about the effectiveness of center programs. This means budgeting between 7-10 percent of the grant for evaluation purposes. For advisory panels, this may constitute budgeting for honorariums and all meeting expenses.

Notes on Sample Selection Criteria and Survey Structure

The selection criteria were (1) projects that were active for at least one year at the time of the survey, or (2) new projects that were continuations of past NSF awards, and (3) projects that were active at the time the survey was administered. During the survey administration period, 5 projects were removed from the sample. Two projects were removed because we were notified their grants had expired prior to the survey period. One project was mistakenly included—it was a planning grant. One project was removed because its continuation grant was also in the sample—i.e., these awards overlapped by more than a year. One was removed at the request of NSF because its grant was mistakenly classified as an ATE grant, resulting in 158 ATE-funded projects, centers, and articulation partnerships, of which 4 (2.5%) never opened—completed—the survey. Ninety-seven percent (154) completed and submitted survey responses within the prescribed time frame (February-March 2004). Therefore, the final sample obtained for the 2004 survey was $N = 154$.

The 2004 survey contained seven sections, as opposed to the nine sections presented in previous years. Changes to the survey structure are listed below:

1. Combination of three program improvement sections—one for each education level served by the program—into one section.

2. Addition of a section dedicated to Articulation Agreement activities.

3. Removal of the Principal Investigator Overview (PI Overview) section.

The principal investigator for the project was asked to respond or assign another person(s) to respond for the grant. All grantees in the sample were asked to complete three sections: (1) Grantee Characteristics–confirming general information collected from other sources (e.g., name of principal investigator and the nature and duration of grant), (2) Organizational Practices–addressing efforts to monitor and evaluate the grant, and (3) Collaboration–addressing ongoing relationships that provide other forms of support to grantees.

Each grantee was then asked to complete one or more additional sections focusing on the primary categories of work the ATE program supports: Materials Development, Professional Development, Program Improvement, and Articulation Agreements. A large and diverse project or center (i.e., one that engages in all identified types and levels of effort) would be expected to complete all seven sections. The smallest and narrowest of projects would complete the three required sections and at least one additional section.