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STATUS REPORT 2
FINDINGS FROM A SURVEY OF ATE PROJECTS AND CENTERS

INTRODUCTION

The goal of the Advanced Technological Education (ATE) program is to improve the education of technicians in advanced technology fields. The program funds projects to achieve its goal. While the term project is uniformly used by NSF to refer to projects that receive funding, the ATE program has chosen to designate and label its largest and most complex projects as centers. To provide clarity in referencing these groups, the term projects will refer to the smaller grants, centers will refer to the subgroup of larger grants, and *projects* (in italics) will be used to refer to the full group of projects and centers.

The ATE program funded 237 *projects* during the first 6 years of the program, 1994 to 1999. The average award was about $150,000 per year with most running 3 years. Awards were made to 11 centers with an average funding of $800,000 per year, usually funded for 3 years. Some centers received more than one award. Nineteen awards were made to centers during this period.

Eleven centers and 104 projects funded prior to 2000 had not yet completed their grant-funding period when this evaluation began. One project and 1 center agreed to help with the development and pilot testing of our instrument and were not asked to respond to the final survey. The remaining 113 sites were chosen as the sample for our survey.

The purpose of the survey was to better understand the nature of the ATE *projects* and to begin to address the effectiveness of these grants. The survey was web based, and respondents could provide the requested information using their computers once they were given their individual user names and passwords.

The ATE program supports four primary categories of work: collaboration, materials development, professional development, and program improvement. Program improvement is targeted at the secondary school, associate degree, and baccalaureate degree levels. The survey contained six sections addressing the categories of work (the four listed above, with program improvement divided into three sections). There also was a section devoted to the external monitoring of the *projects* and a general information section. In this report, we present findings from the four categories of work and the general information sections.

After accessing the web site where they were presented with a copy of the survey, *project* directors were asked to complete the required sections of monitoring and general information. The remaining survey sections were optional and were to be completed only if they coincided with the work of a *project*. If a section was not relevant—for example, a *project* was only about materials development—*project*

directors were asked to deactivate the unneeded sections by “clicking” on appropriate boxes. Data were gathered during the summer of 2000 with a cutoff date of August 10.

This report is the second of two major reports planned for this project. Briefing and white papers on various topics (e.g., collaboration, materials development, program improvement, professional development, student recruitment) will be provided as well. These reports and papers attend to five general questions:

- What is the nature of the ATE program?
- Is ATE expanding the pool of technicians?
- Is ATE increasing the skill and knowledge level of technicians?
- How can the program be improved?
- What have been the unintended outcomes or effects of the program?

SURVEY INSTRUMENT AND METHODS

In funding the ATE program, the United States Congress[2] mandated four categories of work. In addition, the NSF-ATE program’s guidelines for proposal preparation indicate that emphases should be placed on efforts in the same defined areas. Therefore, in accordance with these governmental guides, we prepared a survey with questions that address the major categories of activities and expected outcomes for projects and centers. These categories are:

- **Collaborations** of *projects* with businesses, industries, educational institutions, and other organizations to achieve *project* objectives.

- **Materials development** conducted by *projects*. "Materials" include one or more courses, modules, process models, and/or other instructional or assessment units. "Development" includes the preparation, adaptation for implementation and/or testing of materials.

- **Program improvement efforts** at the (a) secondary school, (b) associate degree, and (c) baccalaureate degree levels. “Program improvement” refers to multiple, related courses, and/or field experiences for students at the designated education level that lead to a defined outcome such as a degree, certification, or occupational completion point.

- **Professional development efforts** focusing on instruction and/or support provided to teaching faculty and staff to update their knowledge and skills and to train them to teach new or improved curricula effectively.

[2] *Scientific and Advanced-Technology Act of 1992* (PL 102-476), S. 1146, 102d Congress, 138 Congressional Record 2297-2301 (1992)

The survey had a total of eight sections. Six of the survey sections addressed the "work" categories mentioned above with "Program Improvement" being divided into three parts to address three educational levels (secondary, associate, baccalaureate). There also was a section devoted to general information and another to monitoring. The general information and six work category sections are the focus of this report.

Each respondent (*project*) was called upon to complete only the work category-related survey sections that were pertinent to its funded work. Additionally, the survey employed an Internet, web-based set of forms to collect data.

SURVEY SAMPLE

Pilot Testing

One project and one center participated in an informal walkthrough of the survey in early 2000. In April and early May 2000, seven projects and two centers (9 in total) engaged in the formal pilot test of the survey. Modifications to the survey organization, format, and item wording were based on input from these pilots.

Survey Process

Prior to May 1, 2000, we notified, by email, the *project* directors/principal investigators of 96 projects and 8 centers that met our inclusion criteria (i.e., current funding and received funding prior to 2000) regarding the forthcoming survey. We also asked them to check their browsers to ensure that they could access and complete the survey when the final form of the survey was released. On May 17, each *project* director was contacted again via email. The email message requested the *projects'* assistance in providing data via a web-based survey. The purposes of the survey were described and the web address for the survey, the user names, and passwords were provided to enable access to the survey.

We extended the closing date of the survey from June 1 to August 10, 2000, to give *projects* more time to complete the survey. During the month of July, Dr. Teles corresponded with *project* directors and asked them to complete the survey. As of August 10, 89 percent of the *projects* replied to the survey. A reply means that the *project* director logged on and submitted information for a least 1 of the 8 sections of the survey. Seventy percent completed and submitted a full survey as requested. Please see Tables 1 and 2 for a more complete breakdown of the survey response rate for the combined formal pilot (9) and regular surveys (104), overall and for each section. Because a nonresponse bias study has not yet been conducted, it is not possible to generalize these findings to all 113 *projects* or to the total program. However, to date, we have no evidence to believe that the respondents were substantially different from the nonrespondents.

Data used in this report includes the formal pilot study as well as the regular survey. We did not ask pilot sites to complete the final form of the survey because the information provided by pilot sites is consistent with that requested in the final survey form and the information provided by pilot sites would not likely change in the time between the pilot and the regular survey.

Table 1. Survey Response Rate–Overall

	Number Completing the Survey (A)	Total Possible Number to Complete the Survey (B)	Response Rate (A/B) Percent
Projects	79	113	70%

Notes:
(A): Respondent completed applicable survey sections and performed survey close (i.e., final submit and close step) (9 formal pilot + 70 regular).

(B): Formal pilot and regular surveys combined (9 formal pilot + 104 regular). Total includes 6 no logins (i.e., did not "open" on-line survey).

As Table 2 shows, the response rate varies by section of the survey. At the start of the survey, respondents were asked to respond only to sections relevant to their funded work. Each responding *project* then could "deactivate" any or all of the six work sections. The monitoring and general information sections were required for all *projects.*

To "close" a survey required several actions on the part of the *project* director: "freezing" the survey to stop entry of data by any other authorized *project* respondent, final reviewing of survey entries, completing general information about the *project*, and performing a final submit and close survey.

Because of the way in which the survey was constructed, even when the survey was not closed, we received data for each section of the survey completed. We have included response data from every *project* that completed at least one section, whether or not the *project* closed the survey.

Table 2. Survey Response Rate By Section*

Section	No. Completing the Survey Section (A)	Total Possible Number to Complete the Survey Section (B)	Section Response Rate (A/B) Percent (%)
Collaboration	68	88	77%
Materials Development	75	96	78%

Table 2. Survey Response Rate By Section*			
Section	**No. Completing the Survey Section (A)**	**Total Possible Number to Complete the Survey Section (B)**	**Section Response Rate (A/B) Percent (%)**
Program Improvement-Secondary	27	47	57%
Program Improvement-Associate	53	79	67%
Program Improvement-Baccalaureate	19	37	51%
Professional Development	67	92	73%
Monitoring	100	113	89%
General Information	84	113	74%

Notes:
* Reported for formal pilot and regular combined and *projects*

(A): *Respondent completed the section* (may or may not have performed survey close)
(B): *Total Possible Number to Complete the Section* is equal to the number of respondents who kept the section activated plus the number of no login *projects* (6). General Information and Monitoring were required of all *projects.*

SURVEY FINDINGS

This report focuses on the four primary work categories–collaboration, materials development, program improvement, and professional development–with a brief section on the findings from the general information on the *projects*. This information (nature and scope of activity and general program patterns) is presented first to provide context for the more narrowly focused work sections. Collaboration is described second because *projects* so uniformly used collaborations to conduct their work. For each, we briefly describe results from the survey regarding the nature of program, the impact that this program component is having, and the quality and effectiveness of these program efforts.

Nature and Scope of Activity

The ATE program expects its *projects* to collaborate, develop materials, improve their programs of instruction, and provide professional development to disseminate the model materials and programs developed. Neither Congress nor NSF has specified what number or proportion of the ATE *projects* should be engaged in each of the identified work categories. Neither have they stated the exact nature of work necessary

to improve the workforce capabilities of technicians in our nation. Without such specifications, we cannot render judgments about the adequacy of these *projects* in such matters as sufficient collaboration, adequate resources for professional development, and so forth. Instead, the primary findings for each category of work are largely descriptive and serve as a baseline from which future actions can be tracked and ultimately judged.

Table 3 provides a breakdown of the nature of work conducted by the 91 *projects* responding to at least one of the work sections. Presuming the responses are representative of the ATE program, 75 percent of the *projects* engage in collaboration, 82 percent engage in materials development, 63 percent engage in program improvement, and 74 percent engage in professional development.

Table 3. No. of *Projects* Engaged in Various Combinations of Work Categories

Work Category Combinations*	Number of Respondents in Each Combination	Number of Respondents in Combination Category
C, MD, PI, PD (all 4)	37	37
C, MD, PI (3 of 4)	6	25
C, MD, PD (3 of 4)	10	
C, PI, PD (3 of 4)	2	
MD, PI, PD (3 of 4)	7	
C, MD (2 of 4)	4	15
C, PI (2 of 4)	1	
C, PD (2 of 4)	2	
MD, PI (2 of 4)	1	
MD, PD (2 of 4)	7	
PI, PD (2 of 4)	0	
C (1 of 4)	6	14
MD (1 of 4)	3	
PI (1 of 4)	3	
PD (1 of 4)	2	
Total	91	91

Notes:
*C=Collaboration, MD=Materials Development, PI=Program Improvement (at least one of the three levels [secondary, associate, baccalaureate] under this category), PD=Professional Development

More importantly, as Table 3 and Figure 1 show, most *projects* engage in several categories of work effort. Indeed, the typical *project* engages in work efforts related to at least 3 of the 4 work categories.

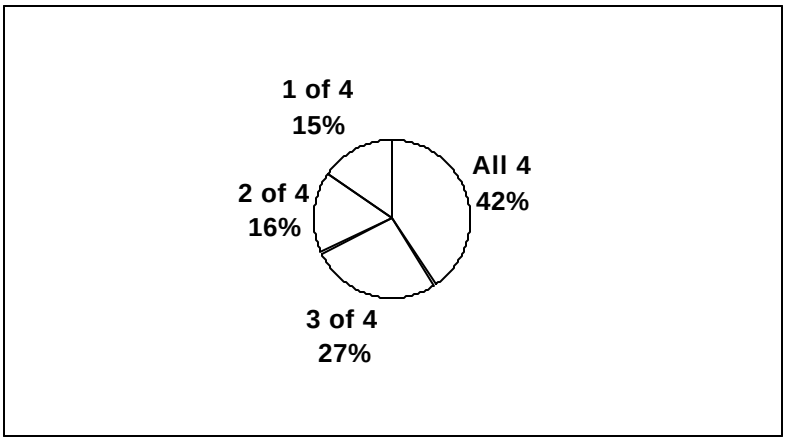

Figure 1. No. of Work Categories Addressed by Respondents in Table 3

Two of the work categories require additional description. First, because program improvement efforts address three different educational levels that likely occur at different physical locations, the program improvement section was divided into three parts. A *project* responded to as many sections as were pertinent to its work. Altogether, 57 *projects* noted their involvement in these efforts. As Figure 2 shows, nearly half engaged in program improvement at two or all three of the secondary, associate, and baccalaureate degree levels. Table 20 provides a breakdown of these various combinations. Such cross-level development efforts indicate attention to developing cross-institution-compatible programs and/or program partnerships.

Second, centers are expected to develop collaborative relations with other organizations including education, public agencies, foundations, and especially business and industries. Projects, too, are encouraged to develop such collaborations. The survey responses suggest that approximately 75 percent of the *projects* engage in collaborative activities.

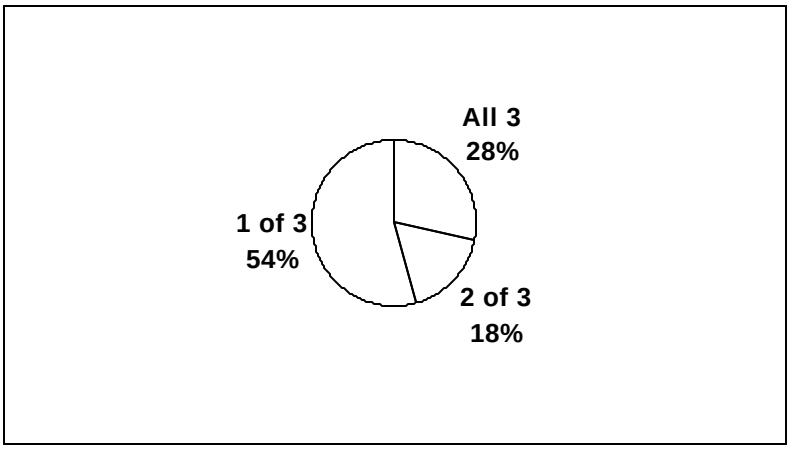

Figure 2. Percentage of Respondents Addressing Program Improvement Level Combinations (Secondary, Associate, Baccalaureate)

General Program Patterns

The *projects* are actively addressing the goals of the ATE program. Four general indicators of *project* health (number of work categories in which *projects* engage, general health questions, unintended outcomes, and data gathering efforts) were used. On every indicator, the findings were positive.

Work Categories

As described in the previous section, *projects* engage in work that is consistent with the expectations of the ATE program as set forth in NSF guidelines and the general mandate of Congress. Every respondent who completed the survey reported work in at least one of the four targeted categories.

Project Stability

Each *project* director/principal investigator was asked to complete a section of the survey that addressed several aspects related to the general health of the ATE program. This section was comprised of 12 items, 10 of which required open-ended answers for all or part of the questions embedded in the item.

The first item asked respondents to rate the *project's* current status against its status a year previous on a set of factors. Since not all *projects* engage in the same types of activities, not all status factors were pertinent to all *projects*.

Results for item 1 are shown in Tables 4 and 5. These results suggest that *projects* generally are thriving. On all 8 factors, for projects, the trend is at least stable. For centers, this is true for all the factors. For projects, five of the factors have medians of at

least four (some increase). It is especially noteworthy that in the important matters of use of developed products, direct participation with other institutions and organizations, and student enrollment, the large majority of projects indicate either some increase or a substantial increase.

Table 4. Project Ratings of Current Status Versus Status a Year Ago (n = 76)

Factor	S-D (%)	D (%)	Stable (%)	I (%)	S-I (%)
Size of staff (n=66)	8	8	63	15	6
Financial support from other organizations (n=55)	4	5	60	20	11
Income from center/project-developed products (n=14)	0	7	64	22	7
Use of center/project-developed products (n=57)	0	2	26	44	28
Direct participation by other institutions and organizations (n=66)	0	1	32	47	20
Students enrolled (n=51)	4	6	31	31	28
Student placed in related technical jobs, whether they completed program or not (n=36)	0	0	44	50	6
Students graduating or completing the program (n=36)	0	15	29	41	15

Notes. S-D= Substantial Decline (>20%), D=Some Decline (5-20%), I= Some Increase (5-20%), S-I=Substantial Increase (>20%)

Table 5. Center Ratings of Current Status Versus Status a Year Ago (n = 8)

Factor	S-D (%)	D (%)	Stable (%)	I (%)	S-I (%)
Size of staff (n=8)	25	25	12	38	0
Financial support from other organizations (n=8)	0	0	38	50	12

Table 5. Center Ratings of Current Status Versus Status a Year Ago (n = 8)					
Factor	**S-D (%)**	**D (%)**	**Stable (%)**	**I (%)**	**S-I (%)**
Income from center/project-developed products (n=6)	0	0	33	67	0
Use of center/project-developed products (n=7)	0	0	14	57	29
Direct participation by other institutions and organizations (n=8)	0	0	12	63	25
Students enrolled (n=6)	0	0	17	33	50
Student placed in related technical jobs, whether they completed program or not (n=6)	0	0	17	50	33
Students graduating or completing the program (n=5)	0	0	20	60	20
Notes. S-D= Substantial Decline (>20%), D=Some Decline (5-20%), I= Some Increase (5-20%), S-I=Substantial Increase (>20%)					

Unintended Outcomes

When respondents were asked to describe significant unintended outcomes (positive and/or negative) of their *projects'* work, most were positive in nature. The unintended outcome most cited by respondents was the successful use of partnerships and networking (15). Table 6 provides a summary of some of the most common responses.

Table 6. Unintended Outcomes Categories and Examples	
Categories	**Examples**
Additional Funding Received	Faculty are writing proposals for external funding more than we ever would have imagined We have received additional funding from the USDA to conduct an evaluation of existing curricula and text materials. This survey will be distributed nationally.

Table 6. Unintended Outcomes Categories and Examples	
Categories	**Examples**
Partnerships, Networks, Collaborations	Excellent relations with partners. The collaborative interaction between the five consortium colleges has lead to the development of many other significant projects. The development of the interactive video and Internet networks among the high schools, colleges, and universities has been incredible. The level of resource sharing taking place continues to amaze me daily. The opportunity that the *project* director and instructors from other collaborating schools have assumed as leaders within their states in precision agriculture education. The intent of the *project* was to assist them in developing local programs. All 6 states within our network have relied on our collaborating schools for professional development activities in their respective states. This has resulted in an indirect benefit to a large number of schools. Teachers tell us that their networking opportunities with colleagues have been increased by work in our *project*. Many teachers reported that our *project* was the first time that they saw themselves as part of a larger "department" than their single classroom.
Applications to Other Disciplines/Work with Other Disciplines	Greater interest on the part of other science disciplines (e.g., chemistry) to better understand and document their two-year college faculty and programs. The most positive outcome is the portability of the module architecture and development methodology to other disciplines and to industry applications.
Full enrollment	This program is becoming very popular and our institutes are very full due to school district requests to train teachers for their very popular materials technology classes. The fear of the school administration before the * proposal was submitted is that students would not enroll in such a rigorous technology program. The fact we have almost 50 percent more students that want to get in than we have space for is fantastic. Maybe we should have aimed higher!
Notes: Asterisks (*) were substituted for specific *project* or program names.	

Barriers/Challenges

Respondents also identified several barriers or challenges to the success that occurred in their *projects*. The most common included lack of time and money (27), lack of administrative support (12), faculty having difficulty adapting to the changes needed for the new programs (11), attracting faculty (8), and communication (7). Some comments have been provided to illustrate these barriers/challenges.

C Lack of Time and Money

Software development is much more time consuming than estimated. Continuous changes in the software environment make development difficult. Every time a software package changes we must check to make sure what we developed previously remains compatible.

Time commitments of the *project* director. Even if the time to finish a *project* is carefully "overestimated", it never seems to be enough.

Time. Community college faculty have heavy teaching schedules, making it very difficult to find time to do creative work, even with a one or two course reduction.

The *project* underestimated the time and money needed to demonstrate the importance of critical issues to classroom teaching. The regions took about two years to form a comfort level for communication, leaving only one year to understand what the critical issues are and their impact on all * classrooms. The *project* needed a couple more years of time and funding to address this concern at the local level.

The biggest barrier or challenge to this *project* has been maintaining the communication and continued feedback of the academic advisors and authors who originally agreed to work on this project. Since all of these individuals are active professionals at their own institutions, often times the 2-3 year commitment that we require for this *project* has been too time-consuming for them to maintain. Several people have been unable to fulfill their contractual obligations because they just didn't have enough time to devote to authoring and reviewing the materials.

C Lack of Administrative Support

A lack of vision on the part of far too many administrators in higher education.

Lack of administrative support both financially and in terms of vision.

Administration has been slow to institutionalize what is considered amongst faculty and particularly students an excellent and viable program.

C Faculty Issues with Adapting to Change

It is very hard for long-time lecture-based faculty to change their view of how learning occurs.

General education faculty were hesitant to work with technical faculty to integrate the competencies.

Doing things differently that do not fit the traditional mold of education institutions, i.e., competency-based curricula, create and require a lot of extra work to educate those not involved.

Faculty belligerent toward industry presenters. "Give us money and equipment and go away . . . we know it all"

Faculty unwilling to collaborate and communicate with other faculty.

Faculty unwilling to learn about the real workplace environment - "Ethics have nothing to do with engineering and technology." "Communications, teamwork, and problem solving are not my job - someone else should be teaching them those skills."

C **Attracting Faculty**

Project time line depended on hiring of additional faculty or releasing current faculty in the three subaward colleges. Difficulty in recruiting and hiring qualified faculty impacted time line for other *project* deliverables.

Needs Assessments

Because needs assessments are viewed as an essential tool to guide *project* work, respondents were asked to identify if and when in the *project* life they conducted a needs assessment. Of the 84 respondents, 75 percent reported conducting a workforce needs assessment prior to submitting their proposal for the *project* to NSF. Fifty-seven percent indicated they conducted a needs assessment after they received funding.

Project Evaluation

Three questions were asked regarding *project* evaluations, all pertaining to whether the *project* used an evaluator. None addressed any matters of extent or quality of the evaluations being conducted. Of the 84 respondents, 83 percent indicated they have an evaluator. Most (73%) of the 70 *projects* having an evaluator, employ an evaluator that is external to the *project*, but 24 percent indicate use of both an external and internal evaluator.

Collaborations

A basic premise of Congress and NSF is that in order to better prepare the workforce to meet business and industry needs for technicians, the associate-degree-level institutions must develop and implement strong collaborative working relationships with a variety of institutions, all of whom are interested in expanding the skill and knowledge of technicians. NSF, in turn, has made development of collaborations among these groups an expected outcome of the ATE *projects*.

Nature and Extent of Collaborations

ATE *projects* have established a large number of collaborative arrangements. The collaborations serve multiple purposes and provide monetary support as well as other kinds of assistance for materials development, academic programs, and professional development efforts.

Several of the questions posed to *projects* addressed collaboration and are paraphrased below (Items 1-5 of Project & Center Work–Collaboration).

- The amount of money and the monetary value of in-kind support provided by institutions and organizations to serve the *project's* objectives.
- The number and types of institutions, and the numbers of persons in those institutions, with which the *project* had developed collaborative relationships.
- The types of purposes served by the collaborations and which types of institutions served which purposes.
- *Project* ratings of the level of quality/productivity of the collaborative relationships.
- Which institutional relationships were most effective and the most important products and/or results of those collaborations.

Projects have established a large number of collaborations with business and industry, education, federal and state agencies, and other organizations. Approximately 94 percent of *projects* responding to this section reported work to develop collaborative arrangements with other institutions. The median *project* lists 39 or more collaborative efforts (projects=28, centers=108) and engages slightly more than two people per collaboration (same for projects and centers). Sixty percent reported collaborative work with four or more different types of institutions/organizations.

As Table 7 shows, the most prevalent type of collaboration for projects is with business and industry organizations (79%). Median number of collaborations for this category is five and the median total number of persons collaborating is seven. Centers report the highest median number of collaborations (39 for business and industry).

Table 7. Nature and Extent of Collaborations

Types of Collaborating Institutions	Projects or Centers Reporting Collaborations (of n)	Percent (%)	Number of Collaborations per Institution (Median)	Range (Low-High)	No. of Persons Collaborating per Institution (Median)
Projects (n=58)					
Business and Industry	46	79%	5	1-75	7
Public Agencies	27	47%	3	1-24	4

Table 7. Nature and Extent of Collaborations

Types of Collaborating Institutions	Projects or Centers Reporting Collaborations (of n)	Percent (%)	Number of Collaborations per Institution (Median)	Range (Low-High)	No. of Persons Collaborating per Institution (Median)
Organizations and Professional Societies	35	60%	2	1-5	5
Secondary Education (e.g., high schools)	31	53%	5	1-50	10
Associate Degree Level Education Institutions	33	57%	4	1-75	8
Baccalaureate Degree Colleges or Universities	32	55%	2	1-75	4
Other	9	15%	2	1-5	6
Centers (n=9)					
Business and Industry	9	100%	39	5-63	9
Public Agencies	9	100%	3	1-27	9
Organizations and Professional Societies	7	78%	4	2-6	7
Secondary Education (e.g., high schools)	9	100%	9	1-122	9
Associate Degree Level Education Institutions	9	100%	15	4-84	9
Baccalaureate Degree Colleges or Universities	9	100%	5	1-12	9
Other	1	11%	2	2-2	1

Projects report having received nearly $14,000,000 in direct contributions of money and more than $16,000,000 in in-kind support (Table 8). Individual centers tend to receive more contributed money than do projects. Viewed from a cost-sharing basis (total of all non-NSF dollars divided by NSF grant dollars for reporting *projects*), contributions to date amount to 18 percent for projects and 30 percent for centers. For in-kind support, the reverse is true. There, the cost-sharing percentage for reporting *projects* is 34 percent for projects and 18 percent for centers. These contributions increase the working resources of reporting *projects* by approximately 50 percent.

Table 8. Total Received to Date by *Projects* by Type of Institution n=67, 58 projects (P), 9 centers (C)		
Type of Supporting Institution	**Total Monetary Support Received to Date**	**Estimated Monetary Value of In-Kind Support**
Lead Institution	2,053,535 (P) 850,236 (C)	1,828,792 (P) 1,206,303 (C)
Foundations	536,750 (P) 0 (C)	38,750 (P) 0 (C)
Business & Industry	683,100 (P) 659,000 (C)	7,308,100 (P) 2,767,000 (C)
Local & State Public Agencies	1,413,500 (P) 2,612,000 (C)	375,525 (P) 8,000 (C)
Non-NSF Federal Sources	521,000 (P) 1,872,500 (C)	320,500 (P) 350,000 (C)
Organizations and Professional Societies	14,600 (P) 65,000 (C)	785,675 (P) 3,050 (C)
Secondary Education	626,001 (P) 875,000 (C)	140,225 (P) 11,550 (C)
Associate Degree Level Institutions	231,500 (P) 95,000 (C)	212,425 (P) 38,000 (C)
Baccalaureate Degree Colleges or Universities	31,250 (P) 0 (C)	273,797 (P) 41,500 (C)
Income from Products and Services	70,000 (P) 395,130 (C)	0 (P) 0 (C)
Other	1,000 (P) 90,000 (C)	554,000 (P) 23,979 (C)
Total from All Non-NSF Sources (A)	6,182,236 (P) 7,513,866 (C)	11,837,789 (P) 4,449,382 (C)
Total NSF $ for Reporting Projects and Centers (B)	34,388,495 (P) 25,350,746 (C)	34,388,495 (P) 25,350,746 (C)
Cost Sharing Percentage ((A/B) x 100)	18% (P) 30% (C)	34% (P) 18% (C)

We asked *projects* to report the number of collaborations they initiated to serve *project* objectives. Four categories of collaboration and four types of institutions were identified

to clarify purposes served. Each collaboration category in turn included several types of activities.

As the summary Table 9 shows, more than 15,000 collaborative efforts have been initiated by the reporting *projects.* Since some of these *projects* have multidimensional collaborations (e.g., a business/industry partner may collaborate for general support and professional development purposes), many of the 15,000 collaborations were reported by the *projects* in more than one category. The exact number cannot be determined from available data. The maximum number of times that a collaboration could be counted is 15 (i.e., total number of purposes listed in Table 10). If that unlikely event always occurred, the total number of unique collaborations would still be larger than 1,000–nearly 10 collaborations per *project*. Approximately a quarter of the collaborations are general in nature, providing advice, general assistance, and equipment. The large majority are intended to serve materials development, program improvement, and professional development purposes

Table 9. Number of Collaborations by Different Types of Organizations and Specified Purposes
n=67, 58 projects (P), 9 centers (C)

General Category	Business or Industry	Public Agencies	Educational Institutions	Other Organizations	Total
General Support	1,038(P) 377(C)	284(P) 95(C)	938(P) 602(C)	98(P) 27(C)	2,358(P) 1,101(C)
Materials Development	652(P) 353(C)	120(P) 57(C)	981(P) 820(C)	51(P) 8(C)	1,804(P) 1,238(C)
Academic Programs	1,736(P) 281(C)	202(P) 23(C)	1,512(P) 590(C)	597(P) 1(C)	4,047(P) 895(C)
Professional Development	813(P) 410(C)	215(P) 122(C)	1,319(P) 766(C)	293(P) 50(C)	2,640(P) 1,348(C)
Total for *Projects*	5,660	1,118	7,528	1,125	15,431

Table 10 breaks down the collaborations by activity to more clearly show the nature of collaborative purposes and activities. Table 10 “counts” involvement. Those respondents that reported at least one collaborator of a type were counted (i.e., given a value of one). Those that did not list any collaborators of that type were not counted (i.e., scored as zero).

Table 10. Percent of *Projects* that Collaborate with the Different Types of Organizations to Serve Specified Purposes
n = 67, 58 projects (P), 9 centers (C)

Purpose	Business or Industry	Educ. Institutions	Public Agencies	Other Organiza-tions
General Support				
Advice (e.g., advisory panel)	76% (P) 100% (C)	70% (P) 100% (C)	49% (P) 89% (C)	41% (P) 67% (C)
Contributed time and effort (beyond advice)	64% (P) 100% (C)	63% (P) 89% (C)	37% (P) 78% (C)	25% (P) 33% (C)
Contributed or shared equipment/technology	54% (P) 56% (C)	48% (P) 44% (C)	25% (P) 56% (C)	10% (P) 44% (C)
Materials Development				
Determining or confirming materials content	63% (P) 89% (C)	63% (P) 100% (C)	29% (P) 44% (C)	22% (P) 22% (C)
Development or implementation of standards/guidelines	49% (P) 67% (C)	54% (P) 78% (C)	27% (P) 56% (C)	19% (P) 33% (C)
Pilot testing of materials (preliminary testing of materials or portions of materials; usually done with a small numbers of sites)	25% (P) 11% (C)	49% (P) 100% (C)	7% (P) 11% (C)	7% (P) 0% (C)
Field-testing of materials (testing of materials in settings where they will be used; usually larger and more in-depth than pilot testing)	14% (P) 11% (C)	46% (P) 89% (C)	7% (P) 0% (C)	2% (P) 0% (C)
Professional Development				
Faculty/staff knowledge of industry needs, opportunities, and requirements	59% (P) 89% (C)	63% (P) 89% (C)	24% (P) 56% (C)	19% (P) 11% (C)
Faculty/staff knowledge and skill in the discipline	42% (P) 78% (C)	63% (P) 89% (C)	15% (P) 44% (C)	17% (P) 11% (C)
Business and industry representatives' knowledge of educational options and opportunities	54% (P) 89% (C)	36% (P) 78% (C)	22% (P) 44% (C)	22% (P) 22% (C)
Academic Programs				
Student understanding of industry opportunities and requirements	42% (P) 67% (C)	41% (P) 56% (C)	22% (P) 33% (C)	17% (P) 0% (C)
Work-based instruction and experience matters (e.g., internships, practica, etc.)	37% (P) 56% (C)	31% (P) 67% (C)	19% (P) 33% (C)	9% (P) 0% (C)
Student recruitment program	29% (P) 67% (C)	41% (P) 78% (C)	17% (P) 33% (C)	14% (P) 11% (C)
College/school-based instruction matters (e.g., course instruction, field testing of materials, etc.)	24% (P) 33% (C)	59% (P) 78% (C)	19% (P) 22% (C)	15% (P) 0% (C)

Table 10. Percent of *Projects* that Collaborate with the Different Types of Organizations to Serve Specified Purposes
n = 67, 58 projects (P), 9 centers (C)

Purpose	Business or Industry	Educ. Institutions	Public Agencies	Other Organiza-tions
Student entry to the workforce	32% (P) 33% (C)	25% (P) 33% (C)	14% (P) 11% (C)	9% (P) 0% (C)

- ***General Support***. There are two general patterns for general support as illustrated in Table 10. First, most collaborations provide general advice, slightly smaller proportions obtain additional support and assistance, and substantially fewer involve gifts of or sharing of equipment/technology. Similarly, the most collaborations occur with business and industry, with decreasing proportions from educational institutions, public agencies, and other organizations. Thus, the large majority (more than three-fourths) use collaborations with business and industry for general advice purposes, while less than a majority of centers and only 10 percent of projects use collaborations with other organizations for equipment purposes.

- ***Materials Development***. The majority of centers and the majority or near majority of projects work with other educational institutions in all aspects of materials development work from determination of content through testing of developed products. Most *projects* work with business and industry in the early stages of materials development (e.g., determination of content and specifying standards), but only a small proportion are engaged in the pilot and field-testing efforts. The same pattern occurs for public agency and other organization collaborations, but substantially fewer of these collaborations occur for development work and almost none occurs for pilot and field testing.

- ***Professional Development***. Collaborations with business and industry most frequently serve development of faculty knowledge of industry needs and opportunities and correspondingly business and industry knowledge regarding educational options and opportunities. A smaller but substantial proportion (42% for projects, and 78% for centers) engage business and industry for development of faculty skills in the discipline area.

  As would be expected, the large majority of collaborations with educational institutions serve to improve educators' knowledge about business and industry and the discipline area. A smaller proportion of collaborations with educational organizations serve to improve knowledge of those in business and industry of educational options and opportunities.

About half of the centers and fewer than 1 in 4 projects collaborate with public agencies in professional development. Less than a fifth of either centers or projects collaborate with other organizations for professional development purposes.

- ***Academic Programs*.** With one exception (college/school-based instruction matters with educational institutions), less than half the projects identified collaborations with any of the targeted groups on any of the five academic topic areas. Proportionately more centers than projects identified collaborative arrangements pertinent to the listed academic issues. Also, generally lower proportions of *projects* collaborated on academic matters than occurred for other major categories. Again, substantially greater numbers of *projects* collaborate with business and industry and educational institutions than with the other two categories of institutions. Most collaborations with business and industry seem to address three topics: student understanding of industry opportunities and requirements; work-based instruction and experience matters (e.g., internships, practica, etc.); and student recruitment program. Collaborations with academic institutions included the same three categories plus college/school-based instruction matters. A third or fewer of the *projects* collaborated with any of the identified groups on the fifth topic–student entry to the workforce.

Reporting *projects* indicate their satisfaction with the quality of these collaborations as illustrated in Table 11. When asked to rate the quality/productivity of collaborations for the four purposes, projects, on average, rated productivity from good to excellent for the full array of institutions. Centers, on average, rated productivity from satisfactory to good.

Table 11. Overall Ratings of Quality/Productivity of Collaborations Relative to the Specified Purposes.
n=67, 58 projects (P), 9 centers (C)

General Category		Business or Industry			Public Agencies			Educational Institutions			Other Organizations		
	P or C	n	Mean	SD	n	Mean	SD	n	Mean	SD	n	Mean	SD
General Support	P	46	3.46	.66	33	3.52	.67	48	3.44	.74	29	3.62	.49
	C	9	3.44	.88	9	2.89	1.05	9	3.22	.83	6	3.17	.75
Materials Development	P	43	3.30	.74	23	3.35	.83	42	3.48	.74	18	3.56	.86
	C	9	3.00	.87	7	2.43	.79	9	2.89	.60	4	2.50	.58
Academic Programs	P	36	3.31	.75	22	3.32	.72	40	3.43	.75	16	3.44	.89
	C	8	3.00	.93	7	2.57	.98	8	2.50	.53	5	2.60	.55
Professional Development	P	43	3.44	.67	23	3.39	.78	43	3.37	.82	16	3.69	.60
	C	9	3.00	.71	8	2.38	1.06	9	2.89	.33	4	2.50	1.00

Notes: SD=Standard Deviation; Scale of 1=Poor, 2=Satisfactory, 3=Good, 4=Excellent

Enhancing the Quality of Collaborative Efforts

Because the collaborations between *projects* and various types of institutions and organizations serve as building blocks for accomplishing ATE objectives, we asked *projects* to identify characteristics that improve collaborations. The responses are helpful as a means to assist others who plan to develop collaborative arrangements. Additionally, respondents' statements regarding barriers tend to confirm the importance of these improvement characteristics.

The characteristics needed for effective collaborations included mutual benefit (11), commitment (12), common purpose/vision (10), and communications including clear expectations (6) (The parenthetical number following the category identifies the number of responses fitting in that category). Also mentioned was the quality and enthusiasm of the people involved (14). Table 12 provides example responses from the *projects* that help to elaborate and explain what is meant by each category of concern.

Table 12. Factors Enhancing the Productivity of *Projects*

Mutual Benefit Collaborations must be win-win situations. Each partner must have something the other needs/wants (i.e., something of value to "bring to the table") so that everyone both gives and receives throughout the working relationship. This is enhanced by having a shared vision, but a shared vision alone will not make a partnership productive. It usually helps if there is a benefit to both sides, although in the case of our secondary school partner, we are definitely reaping more rewards than they by our association. In other cases, the collaborator might be a materials developer, and they benefit from us including their work on our sessions because we can help dissemination for them.
Common Purpose/Vision Common goals and clearly defined roles are important factors in successful collaboration. Willingness to work together and proceed toward a common goal. The collaborations which seemed to be more effective were those that allowed some face-to-face, unstructured time for faculty to realize a comfort level for communication and to realize a common vision or purpose for the activity or conversation, but with all interactions and communications guided by specifically defined goals and measurable outcomes (e.g., written products addressing the goals).

Table 12. Factors Enhancing the Productivity of *Projects*
Communications Including Clear Expectations The collaborative relationships that have worked for us have usually worked because we maintain good communication with the individuals who are collaborating with us. However, the communication has to be maintained by both sides. We have had authors and content advisors that were involved in the *project* early on and then just disappeared and never contacted us to let us know that they weren't able to be involved in the *project* anymore. Building trust. Knowing in the beginning the expectations and following mutually agreeable agenda. Clear understanding of purpose and tasks**.**
Commitment At least one individual at the partnering institution who is deeply committed to and enthusiastic about the *project* is key to effective collaborative relationships.

The barriers listed complemented the effective characteristics and included lack of time or conflicting responsibilities (25), lack of resources or support (16). Often “time and money” were listed together (12). Nine of the *projects* commented that there were no barriers.

Time is the most prevalently stated reason that collaborations fail. Yet, consistently time interacts with clarity of purpose, priorities, resources, and other matters identified as important to making collaborations productive. This would suggest that the time factor, rather than being the primary barrier, is the reason given most when failure to address other factors crucial to success results in a breakdown of *project* productivity. Table 13 elaborates on these matters and provides several responses that addressed matters or resources, support, and/or time commitments.

Table 13. Barriers to Strong Collaboration and Productivity

Lack of Resources or Support

Public schools in our region have been facing budget cuts and deficits, which has made it difficult for some secondary schools to collaborate with the *project*, permanently revise curricula, and institute new courses. The financial limitations faced by institutions in our largely poor, rural region have created the most strident barriers to effective collaboration.

When conducting community-based projects, students' ability of solving problems often catch agency's attention. This means that students at college and even at secondary school levels can produce professional products. Some industries feel a sense of potential competition when they see students working on real-life projects.

Lack of resources and competing requests for support.

Lack of top-level management support from the businesses for whatever reason.

Lack of administrative support at the local high schools.

We have not experienced any significant barriers working with business and industry. However, our experience with universities and other school systems are a challenge due to long-standing policies and procedures, and tradition.

Misunderstanding or lack of understanding of the “project” idea. Perceived threats from the development of “project” was a barrier to true partnerships with the teacher's union. This has largely been dissipated as the project progressed but it caused a lot of headaches for all in the beginning.

Lack of knowing who all to communicate with, very busy schedules of all involved, lack of institutional support (institutions involved are happy to have the grant, but not committed to growing it), not enough funding. The grant proposal was written for a center, then funded for a project with a limited scope. The new, more limited scope was never well defined in writing with NSF and that was a barrier to progress. I believe the original proposal intended to do too much - doing all of those things required more resources, especially people.

Time and Factors Related to Time

A lack of time is usually the reason why potential collaborators refuse to collaborate. They don't have time to write a chapter or a laboratory experiment, and they don't have time to comment on the print materials that others have written.

Potential business collaborators unable to take the required time off work in order to participate.

The scope of the project - in terms of available resources - has not allowed us to tap in to other possible collaborators who would have been likely to participate. (It takes time and resources to keep collaborators onboard.)

Materials Development

ATE *projects* are developing many materials to support the preparation of technicians. These materials include full courses, adaptations of courses, and modules (e.g., laboratory exercises) that can be incorporated into coursework.

Nature and Extent of Materials Developed

Projects were asked to report the types of materials being developed, the number of each type under development, and their stage of development. For those materials that are far enough along in the development process to be used, we asked how many were being used locally or at other places and how many have been published commercially. The results of those questions are provided in Tables 14 and 15. As those tables show, the *projects* are developing a large number of instructional materials. The reported numbers in the draft and completed stages alone total more than 2,000.

Table 14. Total Number of Materials Developed for *Projects* by Type of Materials Developed and Stage of Development
n = 72, 63 projects (P), 9 centers (C)*

Type of Materials	Stage of Development		
	Draft	Field Test	Complete
Course Development	104 (P) 67 (C)	71 (P) 50 (C)	259 (P) 115 (C)
Course Adaptation for Implementation	65 (P) 19 (C)	35 (P) 14 (C)	110 (P) 44 (C)
Module Development (a component that can be used in more than one course)	263 (P) 274 (C)	231 (P) 175 (C)	246 (P) 231 (C)
Other**	85 (P) 4 (C)	59 (P) 17 (C)	88 (P) 116 (C)
Total	517 (P) 364 (C)	396 (P) 256 (C)	703 (P) 506 (C)

Notes:
* Three projects excluded for incomplete data.
** The large number of items in the Other row is the result of efforts primarily by four projects, each of which is creating a large number of what appear to be small items (e.g., laboratory exercises or job-based problems).
The above stage of development categories *are not* mutually exclusive.

An expectation of these development efforts is that the completed products be of good quality, widely disseminated, and used. Table 15 shows that most developed materials

are used locally, less than half as many are used at sites other than the *project*, and relatively few have been commercially published.

Table 15. Total Number of Materials for *Projects* by Usage
n = 72, 63 projects (P), 9 centers (C)*

Type of Materials	Local Use (A)	Elsewhere (B)	Commercially Published (C)
Course Development	215 (P) 68 (C)	93 (P) 30 (C)	18 (P) 30 (C)
Course Adaptation	101 (P) 44 (C)	16 (P) 14 (C)	18 (P) 0 (C)
Module Development	221 (P) 221 (C)	97 (P) 171 (C)	12 (P) 34 (C)
Other	63 (P) 116 (C)	28 (P) 108 (C)	0 (P) 0 (C)

Notes:
* Three projects excluded for incomplete data.
(A): Locally means at sites with the *project*.
(B): Elsewhere means at sites not a part of the *project*.
(A)-(C): *Are not* mutually exclusive categories

To gain an understanding of target audiences and general content of the materials respondents were asked for descriptive information about each of up to five of their most important materials development efforts. The descriptive information includes (a) title, (b) type of material developed, (c) discipline area, (d) grade level information, and (e) a brief description of the titled material. Table 16 summarizes that information. As this table shows, approximately 80 percent of the developed materials are oriented to the associate degree level. The materials described represent 18 discipline areas. While the strong orientation to the associate degree level is likely to be representative of all materials development efforts, it is likely that the figures underrepresent the discipline areas for which materials are being developed. Quite likely nonrespondent *projects* are developing materials in additional discipline areas.

Table 16. Numbers of Materials Summarized by Discipline Area and Grade Level					
	Educational Level				
Discipline (Field of Technology)	K-12	College First Year	College Second Year	College Upper Level	Total By Field of Technology
Agriculture	1		4		5
Aquaculture	3	2			5
Biotechnology	3	12	6		21
Chemical Technology	3	14	7		24
Distance Learning		1	3		4
Electronics, Instrumentation, Laser and Fiber Optics	3	5	8	1	17
Engineering Technology	4	11	7	1	23
Environmental Technology	3	9	5		17
Geographic Information Systems	4	4	1	1	10
Graphics and Multimedia		3	4		7
Information Technology, Telecommunications	3	12	16		31
Mathematics		9	18	1	28
Manufacturing and Industrial Technology	9	8	7		24
Machine Tool Technology, Metrology			2		2
Marine Technology		2	2		4
General or Multidisciplinary	5	11	1		17
Physics	6	8			14
Semiconductor Manufacturing			1		1
Total Items Developed at Each Educational Level for All Disciplines	47	111	92	4	254

Notes:
Respondents were asked to list up to 5 of the most important materials their *projects* were developing. A combination of 4 types of materials development efforts (total=254) are represented in this table (course development materials [91], course adaptation materials [28], course module materials [87], other types of materials [48])

For the first most important materials development effort, 69 *projects* provided information.
For the second most important materials development effort, 60 *projects* provided information.
For the third most important materials development effort, 50 *projects* provided information.
For the fourth most important materials development effort, 42 *projects* provided information.
For the fifth most important materials development effort, 33 *projects* provided information.

Quality of Materials Development Work

Previously reported items provide some insight to the nature of the materials developed as well as their dissemination and use. The following information directly addresses the element of quality. At best, surveys can only provide proxy evidence of quality. The actual evidence (content validation, student achievement, etc.) must be collected elsewhere to be reported here. The survey solicited information about validation practices, on the premise that good practices are likely to lead to good quality materials. Three general measures of quality were used.

1. The use of industry or other relevant standards as a guide to development of materials. Here two items were pertinent. Both help to assure content validity of the materials.
   a. Industry's verification of content alignment with workforce and skill needs
   b. Use of applicable student and industry-based standards or guidelines to guide development of materials

2. Measures of student success. Good assessment measures, built into instructional materials and/or used in conjunction with the developed materials, help to mark student accomplishments and can be used as guides for both instruction and accountability purposes. Five items addressed assessment measures.
   a. Assess student success (knowledge and skills) in comparison with industry/business standards (American Electronics Association Standards, American Chemical Society Standards, etc.)
   b. Assess student success (knowledge and skills) in comparison with educational standards (SMET foundation standards, AMATYC, National Council of Teachers of Mathematics Standards (NCTM), National Research Council Science Education Standards, etc.)
   c. Assess student success (knowledge and skills) in comparison with nontechnical skill standards (e.g., SCANS)
   d. Assess student success (knowledge and skills) in comparison with other nonproject or nonparticipating students
   e. Assess improvement of student performance in the workforce

3. The extent to which the *project* tests its materials (pilot and field testing[3]) both in development and validations purposes. To address these matters, we used items focusing on the three key types of testing.
   a. Pilot test materials
   b. Field-test materials internally (i.e., within the *project*)
   c. Field-test materials externally (i.e., not *project*-based locations)

[3] Pilot testing refers to brief, preliminary testing of materials or portions of materials; usually done with a small number of sites. Field testing refers to testing of materials in settings where they will be used when finalized; usually large and more in-depth than pilot testing.

In each case, respondents were asked to state the frequency with which they used each measure or technique. Their responses are summarized in Tables 17-20. Table 17 suggests substantial but not complete compliance with the use of industry or other appropriate standards to guide development of materials. As row 4 in the table shows, 55 percent of the projects and 72 percent of the centers state that they use one of the two practices all of the time. Only 5 percent of the projects never or nearly never apply such developmental practices.

Table 17. Frequency of Use of Industry Standards or Other Relevant Guidelines for Developing Materials
n = 72, 63 projects (P), 9 centers (C)

Practice	Used Each Time %	Used Most Times %	Used Less Than Half the Time %	Almost Never or Never Used %	NA %
1. Obtain verification by industry regarding alignment of materials with workforce and skill needs	55 (P) 67 (C)	30 (P) 22 (C)	2 (P) 11 (C)	6 (P) 0 (C)	7 (P) 0 (C)
2. Use applicable student and industry-based standards or guidelines to guide materials development	56 (P) 78 (C)	28 (P) 22 (C)	6 (P) 0 (C)	5 (P) 0 (C)	5 (P) 0 (C)
3. Practice 1 or Practice 2	55 (P) 72 (C)	29 (P) 22 (C)	4 (P) 6 (C)	5 (P) 0 (C)	7 (P) 0 (C)

Table 18 shows that 42 percent of the projects and 66 percent of the centers apply one or more of the identified student measures most of the time or each time. Because most materials are developed to enhance student learning in identified areas of need for SMET basic skills or industry based identified areas of need, assessment of student achievement should be considered a requisite for feedback in the developmental process. The varied materials being developed make it appropriate to apply different student assessment methods in the development process. A high percentage of *projects* apply at least one of the methods all of the time in their development processes. Eighteen percent of projects and four percent of centers make little or no use of these student assessment techniques, though they deem them applicable. The fact that this percentage of projects and centers do not always seek such feedback indicates there is room for improvement.

Table 18. Frequency of Use of Measures of Student Success
n = 72, 63 projects (P), 9 centers (C)

Practice	Used Each Time %	Used Most Times %	Used Less Than Half the Time %	Almost Never or Never Used %	NA %
1. Assess student success (knowledge and skills) in comparison with industry/business standards (American Electronics Association Standards, American Chemical Society Standards, etc.)	25 (P) 56 (C)	21 (P) 11 (C)	21 (P) 0 (C)	12 (P) 0 (C)	21 (P) 33 (C)
2. Assess student's success (knowledge and skills) in comparison with educational standards (SMET foundation standards, AMATYC, National Council of Teachers of Mathematics Standards (NCTM), National Research Council Science Education Standards, etc.)	24 (P) 33 (C)	12 (P) 45 (C)	15 (P) 11 (C)	23 (P) 0 (C)	26 (P) 11 (C)
3. Assess student success (knowledge and skills) in comparison with nontechnical skill standards (e.g., SCANS)	26 (P) 67 (C)	17 (P) 22 (C)	17 (P) 0 (C)	18 (P) 0 (C)	22 (P) 11 (C)
4. Assess student success (knowledge and skills) in comparison with other nonproject or nonparticipating students	20 (P) 34 (C)	17 (P) 11 (C)	15 (P) 22 (C)	24 (P) 11 (C)	24 (P) 22 (C)
5. Assess improvement of student performance in the workforce	24 (P) 33 (C)	21 (P) 22 (C)	11 (P) 11 (C)	15 (P) 11 (C)	29 (P) 23 (C)
6. Applies one or more of the five identified student measures	24 (P) 44 (C)	18 (P) 22 (C)	16 (P) 9 (C)	18 (P) 4 (C)	24 (P) 21 (C)

Validation is always an important step in development of new materials, but it is especially so in development of materials that are intended to be widely distributed. Two primary steps are routinely taken in validation of materials. The first is called pilot testing. In this process, the developers have persons or groups of persons try out the materials to ensure that the materials are understood, properly employed, learned, and so forth. The second, called field-testing, is routinely done when it is believed the materials are ready for dissemination. This testing ensures such things as (a) that the newly developed materials can be applied by persons who are not privy to development

information and (b) that when used the materials result in appropriate student learning. Field testing is particularly important to the process because often when materials are applied outside the bounds and influence of the developers the materials are misunderstood and/or misapplied, leading to poor student learning.

Developers were not asked whether their products performed well under pilot and field-testing conditions. Rather, they were asked only whether they had conducted these tests. As such, a positive response does not provide assurance of quality. Nor does lack of a positive response mean that the quality of the developed materials is poor. However, failure to carefully field-test developed materials does indicate a measure of negligence. As Table 19 shows, while a majority of *projects* do pilot and field-test within their own *projects*, there is room for improvement in regard to external field-testing (only 49 percent [projects] and 66 percent [centers] conduct such tests each or most times).

Table 19. The Extent to Which the *Projects* Test Their Materials
n = 72, 63 projects (P), 9 centers (C)

Practice	Used Each Time %	Used Most Times %	Used Less Than Half the Time %	Almost Never or Never Used %	NA %
1. Pilot test materials	53 (P) 67 (C)	24 (P) 22 (C)	9 (P) 11 (C)	9 (P) 0 (C)	5 (P) 0 (C)
2. Field-test materials internally (i.e., within the *project*)	64 (P) 44 (C)	23 (P) 56 (C)	6 (P) 0 (C)	3 (P) 0 (C)	5 (P) 0 (C)
3. Field-test materials externally (i.e., not *project*-based locations)	32 (P) 44 (C)	17 (P) 22 (C)	18 (P) 11 (C)	20 (P) 11 (C)	13 (P) 12 (C)

Developers Statements of "Most Compelling Evidence of Quality"

Those who completed the Materials Development section were asked to select one item they had developed and state what they considered to be the most compelling evidence for its quality. Seventy-two (72) persons responded. Their responses suggest that most products complete the development stage without being fully field-tested and validated. The responses also suggest respondents tend to confuse the idea of field trials (having others try out the materials) with field tests to establish validity (effectiveness) of the materials.

Most responses refer to personal or group testimonials about the quality of the materials, and some refer to acceptance and use by other institutions as "best evidence." Some argue that because students who used the materials obtained employment and received good salaries the quality is good. Some refer to field or pilot situations that resulted in positive reviews by clients, students, or teachers. Only the following 4 of 72 offered what might be termed concrete evidence of quality.

- Retention rates in – ET Core classes have soared from previous rates of 40 percent or less to 88-100 percent per semester.

- Helped to improve basic skills of students in field tests based on pre and posttests using the ASSET instrument.

- Student reaction and result of pre and posttests in both student attitude and knowledge.

- When the methodology was used correctly, the learning that resulted for participating faculty was significantly higher than when the methodology was not used. We used a quasi-experimental pre-posttest design.

These comments suggest almost total reliance on reviews and statements of satisfaction by users.

Program Improvement

Projects are improving their technician-based programs by constructing new courses, modifying existing courses, and taking steps to better serve students in matters of recruitment, retention, placement, and diversity.

Nature and Extent of Program Improvement

As previously noted, *projects* were funded to develop model programs of instruction at the secondary, associate degree, and baccalaureate levels. Because the general characteristics of program improvement were comparable across the three educational levels, a general form for the program improvement section was prepared and repeated for each level. Respondents were asked about types of courses, the possibility of transferring those courses, and numbers and types of students participating in their program. Numbers of *projects* responding to the program improvement items were provided in the nature and scope of activity section of this report (pp. 7-8).

As Table 20 shows, program improvement efforts are focused primarily at the associate degree institutions. Ninety-three percent of the respondents report program improvement efforts at the associate degree level, nearly half (47%) are located at the secondary level, and a third at the baccalaureate level.

Nearly half (48%) of the reporting *projects* conduct programs that engage at least two levels, and 28 percent engage all three levels. In terms of actual number of programs being improved, 38 percent of the work is being conducted through programs that address all three levels. These figures suggest that a substantial amount of work is being conducted to develop articulated programs across educational levels, chiefly between associate degree institutions and others.

Table 20. Total Number of Programs Developed/Offered by Type of Degree Level or Degree Level Combination
n=57, 48 projects (P), 9 centers (C)

Type of Degree Level or Degree Level Combination	Projects and Centers Reporting	Total Number of Programs Developed/Offered
Secondary (Exclusively)	2 (P)	6 (P)
Associate Degree Level (Exclusively)	25 (P) 4 (C)	107 (P) 61 (C)
Baccalaureate Degree Level (Exclusively)	0	0
Secondary-Associate	7 (P)	36 (P)
Secondary-Baccalaureate	2 (P)	15 (P)
Associate-Baccalaureate	1 (P)	5 (P)
Secondary-Associate-Baccalaureate	11 (P) 5 (C)	100 (P) 41 (C)
Total	48 (P) 9 (C)	269 (P) 102 (C)

Respondents were asked to identify a specific program (if more than one was under development) and one specific institution, and provide additional information about program improvement efforts for that specific case. As a result, the findings provide at best a rough estimation of actual productivity in program improvement.

The survey provided an opportunity to identify development work in seven types of courses. For each type, respondents were asked to identify courses developed as part of the grant, courses changed through the grant, and courses that remained unchanged. Table 21 shows that of the 57 *projects* engaged in program improvement, a majority address course development and improvement in basic SMET (science, math, engineering, technology), field-related, and technology-intensive courses. Less than a

majority engage in development of introductory technology, field-based, certification and distance courses, with the fewest engaging in development of distance courses.

Generally, the number of materials developed or revised is consistent with total number engaged in that type of effort. The table also shows a balance between development of new courses and revision of existing courses, typically slightly more are preparing new courses than revising current courses. A notable exception is introductory technology courses.

Table 21. No. of Courses by Type and Category for One Specified Program of *Projects*

Course Category		New Courses (A)			Changed Courses (B)			Unchanged Courses (C)		
	P or C	n	Total no.	Median	n	Total no.	Median	n	Total no.	Median
SMET Courses	P	22	86	2.00	22	87	2.50	19	158	6.00
	C	11	69	3.00	9	61	4.00	9	72	5.00
Field-Based Courses	P	10	12	1.00	5	8	1.00	8	13	1.00
	C	6	6	1.00	4	7	2.00	6	11	1.50
Field-Related Courses	P	25	72	1.00	17	49	2.00	13	92	3.00
	C	7	36	5.00	8	37	2.00	7	42	2.00
Certification Courses	P	8	28	3.00	5	10	2.00	6	15	2.00
	C	5	11	2.00	3	23	2.00	4	26	1.50
Distance Courses	P	6	16	2.50	3	6	2.00	2	6	3.00
	C	4	16	2.00	4	27	4.00	2	29	14.50
Introductory Technology Courses	P	18	48	1.50	14	117	2.50	16	101	1.50
	C	5	12	2.00	8	22	2.00	7	31	2.00
Technology Intensive Courses	P	23	95	3.00	22	70	2.00	18	94	4.00
	C	8	58	5.50	8	52	5.00	8	65	3.00

Notes:
Course categories are not mutually exclusive
A: Courses added as part of this grant
B: Existing courses that were substantially changed through this grant's efforts
C: Current **specified** program courses that existed as is prior to the start of this **specified** program

Some respondents note that their programs are new and have not yet enrolled students. Yet, overall, large numbers of students are being impacted by these programmatic changes. The *projects* report that their programs have enrolled on average a total of 76 and 1,075 persons in their respective secondary and associate-degree-level courses during the past 12 months.

As Table 22 shows, the large majority of associate degree institutions provide a degree or certification in technician programs. Though not shown in the table, 42 percent provide both degree and certification options. A relatively small proportion of the secondary institutions offer these options (17 percent). Three out of the five baccalaureate programs offered these two options.

Table 22. Characteristics of the *Projects'* Technician Programs by Degree Level

Program Characteristics	Secondary School (n=18) %	Associate Degree Level (n=36) %	Baccalaureate (n=5) %
A Degree-Based-Major in a Targeted Discipline (n=44)	11%	78%	11%
Certification in a Specific Skill Area (n=30)	23%	70%	7%

Notes:
Each column includes the indicated educational level and all combinations including that level.

Transfer of Course Credits

One of the issues in the education of technicians is the transferability of training. Someone trained at the secondary school level may want to move to a different school or may want to continue training at a higher level. Removing the structural impediments that slow students in moving through the educational system may therefore increase the numbers of people choosing to become technicians and facilitate training at different levels.

Table 23 addresses transferability of course credits to similar institutions and Table 24 addresses transferability to a higher degree level institution. These tables suggest that the programs are striving to develop transferability of credits. As might be expected, there is much more transferability within type of educational institution than across, and the baccalaureate institutions are the least likely to accept transfer credits either from other institutions at their own level or from institutions at other levels.

Table 23. Credit Transfer to Similar Institutions by Type and Projects (P) and Centers (C)						
	Secondary (n=18)		Associate (n=36)		Baccalaureate (n=5)	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
None	4 (P) 0 (C)	29 (P) 0 (C)	0 (P) 0 (C)	0 (P) 0 (C)	1 (P) 0 (C)	25 (P) 0 (C)
Some	3 (P) 0 (C)	21 (P) 0 (C)	10 (P) 2 (C)	35 (P) 29 (C)	0 (P) 0 (C)	0 (P) 0 (C)
Most	1 (P) 2 (C)	7 (P) 50 (C)	8 (P) 4 (C)	27 (P) 57 (C)	1 (P) 1 (C)	25 (P) 100 (C)
All	6 (P) 2 (C)	43 (P) 50 (C)	11 (P) 1 (C)	38 (P) 14 (C)	2 (P) 0 (C)	50 (P) 0 (C)
Notes: **Each column includes the indicated educational level and all combinations including that level.**						

Table 24. Credit Transfers to a Higher Degree Level Institution by Type and Projects (P) and Centers (C)						
	Secondary (n=18)		Associate (n=36)		Baccalaureate (n=5)	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
None	3 (P) 0 (C)	21 (P) 0 (C)	4 (P) 0 (C)	14 (P) 0 (C)	2 (P) 0 (C)	50 (P) 0 (C)
Some	6 (P) 0 (C)	43 (P) 0 (C)	10 (P) 3 (C)	34 (P) 33 (C)	0 (P) 0 (C)	0 (P) 0 (C)
Most	0 (P) 2 (C)	0 (P) 50 (C)	8 (P) 5 (C)	28 (P) 56 (C)	0 (P) 1 (C)	0 (P) 100 (C)
All	5 (P) 2 (C)	36 (P) 50 (C)	7 (P) 1 (C)	24 (P) 11 (C)	2 (P) 0 (C)	50 (P) 0 (C)
Notes: **Each column includes the indicated educational level and all combinations including that level.**						

Course Development and Modification

Much of program improvement is rooted in course development and/or improvement to bring courses up to date with current workforce needs or to improve course substance

in matters of basic science, math, engineering, or technology (SMET). On average, the respondents note creation or changes of 6 courses in a secondary program and 8 courses in an associate degree program.

New courses total 268 of which 61 are at the secondary level, 190 at the associate degree level, and 17 at the baccalaureate level. On average, a project or center developed 4 courses at the secondary level, 5 at the associate degree level, and 6 at the baccalaureate level. Since some of these *projects* have multilevel courses (e.g., associate and baccalaureate), some of the 268 new courses were reported by the *projects* in more than one degree level. This is also true for changed courses.

Changed courses total 239; 50 at the secondary level and 189 at the associate degree level. No changed courses were listed for baccalaureate level programs. On average, a project or center changed 6 courses at the secondary and associate degree levels.

These data represent major changes to the identified programs. Respondents list a total of 434 unchanged courses in the respective secondary (44), associate (353), and baccalaureate (37) levels. When combined with new and changed courses, the data show that for these programs, over half the offerings are undergoing development or modification.

Numbers of Students Reached

To gain a better understanding of program size and program completions, *projects* were asked to specify the number of students enrolled in and completing a specified program during the last 12 months. At the secondary level the average enrollment was 173 students with 125 program completers (n=20 respondents). At the associate degree level, the average enrollment was 94 students with 43 program completers (n= 44 respondents).

These are substantial numbers for the participating institutions. However, viewed on a national scale, the number of institutions and students involved are small. The number of institutions impacted must grow substantially if these new programs are to make more than a small dent in the current need for new technicians. Viewed as model programs, it shows the importance of validating and disseminating these new approaches. Only through substantial dissemination of strong programs growing out of these development efforts will NSF meet Congress' mandate for a sufficient and well-trained technician workforce.

Ethnic and Minority Representation

Table 25 shows reported estimated enrollments in the technical programs at the secondary, associate, and baccalaureate degree levels. These estimates are, at best, crude indicators because *projects* did not provide data for some of the variables. In several cases, *projects* noted that they were just beginning their programs, and no

students would be enrolled until the fall term. Note that in the case of minority and white, which one would expect to add to100 percent, the total falls short for the three degree levels. The results show more diversity at the associate degree level (33% female, 37% minority).

Table 25. Proportion of Students Enrolled in Academic Programs During the Past 12 Months by Student Category and Degree Level (Project (P), Center (C))

Student Descriptor	Secondary Level (n=18)	Associate Degree Level (n=36)	Baccalaureate (n=5)
Female	19% (P) 38% (C)	33% (P) 31% (C)	19% (P) 12% (C)
Minority (Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or other Pacific Islander)	23% (P) 31% (C)	37% (P) 34% (C)	32% (P) 70% (C)
White	71% (P) 50% (C)	59% (P) 38% (C)	68% (P) 13% (C)
Percent of Students Who Requested Accommodation Due to Their Disability under the American with Disabilities Act.	1% (P) 2% (C)	5% (P) 1% (C)	3% (P) 0% (C)

Notes:
Each column includes the indicated educational level and all combinations including that level.

Recruitment and Retention

When respondents were asked to describe their program's recruitment efforts, their responses were quite varied. Responses for retention strategies also varied. There were 51 strategies for retention with the most popular being financial support (19), tutoring (21) and academic advising (11). Six *projects* reported that recruitment was not applicable or that they had no strategies for retention.

One of the goals of the ATE program is to increase the diversity of the workforce. It appears that *projects* are mixed in their responses to dealing with diversity. The two quotes below represent the range of responses to the item about diversity.

"The *project* will involve underrepresented groups when it is farther along. We are in the development stage."

"The department has worked directly with the Student Recruitment (through presentations and tours) and Job Placement Offices (presentations at Technical Careers Week, sponsored by the Workforce Division). The Student Recruitment and Job Placement programs are both funded by Carl Perkins grant funds."

Table 26 provides additional examples from the range of descriptions. Not all descriptions are provided in full. One *project*, for example, listed a 14-point program to recruit students with four special steps taken to recruit minorities. Some comments suggest that programs proceed in recruitment and retention activities without knowledge of what types of activities are likely to be most beneficial. Given the ATE's strong intentions to increase and maintain high diversity, the responses suggest a need to share descriptions and evidence of productivity for recruitment and retention of students among projects and centers.

Table 26. Example Descriptions of Recruitment Activities at the Associate, Secondary, and Baccalaureate Degree Levels

Associate Degree Level
Students are recruited from campus classes, particularly in math and prep chem. Some high school recruitment has occurred, but it less effective than talking to students already on campus.
Guest speakers worked really well, particularly for developmental students, serving as role models.
Partnerships with Skillsnet, Siggraphy, Women in Animation, Visual Special Effects Society, Ed Net, New Media Centers, etc.
All county high schools received promotional materials. Presentations were made to students, teachers, and guidance counselors at high schools. Promotional materials were sent to industry and presentations were made. Presentations were made on the MCC campus to students with undeclared majors. Sponsored technology days for middle and high school students (720 attended). Sponsored activities for high school teachers. High school teachers were engaged as interns during the summer. High school recruiting was focused on inner city schools. Sponsored high school olympiad for the state.
Success stories for both the above include women and African-Americans who have

Table 26. Example Descriptions of Recruitment Activities at the Associate, Secondary, and Baccalaureate Degree Levels
graduated from the program in past years (before NSF-funded improvements).
Field experience for high school students at minority-serving institution.
Attendance at career days and workshops, especially at minority serving institutions, and in communities with high minority populations.
Created a database of all vocational and tech-ed faculty in the state.
Presentations were made to targeted Indian tribes in the region.
Minority and targeted-minority scholarships were provided and promoted.
Sponsored TV ads, sent videotapes to high schools and jr. high schools, conducted training for high school teachers, held summer workshops for students, giving them insight to program, supported and presented at "Career Days" at local high schools.
Women's career outreach: During a six-week period, women identified as single parent, unwed mothers, homemakers, are exposed to a variety of nontraditional skills that are taught at the college. Each enrollee receives hands-on experience welding, machining parts, drawing and designing in CAD, and working in other technical trade areas. The enrollees are also taught job interview skills, resume writing, and workforce ethics.
Secondary Level
Middle school outreach with an emphasis on underrepresented populations. Talks aimed at girls in science programs (e.g., AWIS). Workshops with teachers from middle schools, especially at minority-serving institutions. All students required to take 2 courses. Recruited from those into the other two.
Recruitment used three mechanisms: 1) direct mailing to all 7th and 8th grade students in the * public schools, 2) visits to 8th grade classes in all junior highs, 3) open houses for students and parents, 4) assessment tests. The combination of these all worked very well with over-subscription each of the three years we recruited new freshmen into the program. Industry participants assisted with the recruitment efforts, including minority and female role models. In addition, parent involvement was very high and self generated. The majority of recruitment activities were handled by the * team itself with assistance in mailing from administration.

Table 26. Example Descriptions of Recruitment Activities at the Associate, Secondary, and Baccalaureate Degree Levels
EISC, the sponsoring organization also was actively involved in open houses.
Women in Technology Workshop held for 144 8th grade and high school girls prior to 2000-2001 course sign-up. Videotape followed by small group discussions with local women role models in technology. Increased female sign-up.
Student Parent Night-Overview of the program with industry partners as presenters. Most candidates attended this night. (Excellent)
Television coverage, special State of * ads highlighting technical education. Good response from viewers. Hard to assess.
Letters to math and science teachers. No response.
Baccalaureate
Our campus has hired a full-time recruiter for this next year. I have been involved with several groups, agencies and associations to provide an interface with business and industry. This builds a viable network not only for recruitment, but placement in the workplace.
College catalog, job fairs, community outreach.
Notes. Some items were edited to correct spelling. Asterisks (*) were also substituted for specific *project* or program names.

Placement of Program Completers

Table 27 provides a snapshot *project* estimate of the proportion of students who took technician positions upon completion of the program or continued their education. At the associate-degree level, 73 percent of the students are identified as taking a technician position and 33 percent are going on to higher education for projects (not mutually exclusive categories), with similar findings for centers.

Open-ended responses (Table 28) support the perception that students who complete these programs do find work. Five of 54 reporting *projects* noted that placement of students was not applicable to their particular program improvement. Two indicated that their programs had not yet started. The remaining *projects* identify a variety of activities or indicate that placement support is not needed because their graduates and/or students are in such high demand.

Table 27. Reported Average Proportion of Program Completers Who Take Jobs in Technology or Continue their Higher Education by Degree Level

	Secondary School Level (n=18)	Associate Degree Level (n=36)	Baccalaureate (n=5)
Technician Positions	21% (P) 81% (C)	73% (P) 77% (C)	90% (P) 27% (C)
Higher Education	38% (P) 10% (C)	33% (P) 38% (C)	10% (P) 24% (C)
Number of Student Completions per School Program	44 (P) 545 (C)	38 (P) 83 (C)	20 (P) 75 (C)

Notes: Each column includes the indicated educational level and all combinations including that level.

Table 28. Example *Projects'* Steps Taken to Place Students in Workforce Positions

Department faculty maintain close contact with area laboratories and work with those labs to place students in internships and in full employment.
Contacts with industry are such that we receive requests for graduates, more requests than we can fill. We are in constant contact with companies to monitor the job market and keep employers aware of our program.
We have an articulated agreement for transfer to two four-year institutions. Work closely with industry personnel who have indicated a desire to hire graduates of program when available.
Participation in many industry driven collaboratives and conferences
College participation in * Technology Council internship web site–allows students to post resumes and respond to industry internship postings.
The most successful intervention for placing students at * and in the project are student internships. 15 weeks long (one semester) full time.

Notes. Some items were edited to correct spelling. Asterisks (*) were substituted for specific *project* or program names.

Professional Development

Projects conduct large numbers of professional development activities. These activities are well attended and well received. Where follow-up has occurred, reportedly about half the participants try out the materials and a third implement them.

Nature and Extent of Professional Development

The section of the survey on professional development included 6 items. These items asked:

- Number of professional development opportunities and number of participants
- Percentages of participants who engage in implementation behaviors after participating in the professional development
- Numbers of participants from the different educational levels
- How full the professional development opportunities are
- What sort of support is provided to professional development participants
- What outcomes have resulted from the professional development opportunities.

Fifty-eight (58) projects and nine (9) centers provided information about professional development. As would be expected, however, not all *projects* were engaged in all types of professional development, so the numbers of *projects* varied substantially across items and components of items.

Table 29 shows that in the past 12 months, conferences, workshops and in-service courses were the most popular forms of professional development. Conferences were defined as a multiple track selection of workshops or presentations; workshops as a single track, 1-to-3 day directed learning experience; and in-services as a course or seminar longer than a 3-day directed learning experience. *Projects* report providing a total of 648 large-group offerings, divided among conferences (128), workshops (353), and in-service courses (167). Additionally, much smaller numbers provided internships, on-line courses, and other learning activities (e.g., half the centers and about a sixth of the projects provided internships). Reported center large-group activities tended to include more participants—6 to 10 times as many as the typical project—but the median conference or workshop involved 28 persons, with the median in-service involving 20. Substantial numbers of participants attended these three types of sessions with medians for attendance ranging from 20-28 for projects and 133-334 for centers. As these numbers suggest, the typical center opportunity was much larger and engaged 6 to 12 times more participants than did a typical project.

Internships were offered fairly often but, of course, these involved a smaller number of participants. Few on-line course opportunities were provided. When asked how full the professional development opportunities were 58 projects and 9 centers responded. For projects, 51 percent were at or near full capacity, 25 percent were at or about 3/4 capacity, 16 percent at half capacity, and 8 percent reported operating at less than half

of their capacity. For centers, 78 percent reported they were at or near full capacity and 22 percent reported they were at or about 3/4 capacity.

Table 29. Conference Opportunity and Participation Rates in the Past 12 Months (Projects (P) and Centers (C))

	Number of Opportunities			Number of Participants		
	Reporting (n)	Range	Median	Reporting (n)	Range	Median
Conferences	30 (P) 7 (C)	1-16 (P) 1-5 (C)	3 (P) 3 (C)	30 (P) 7 (C)	1-300 (P) 65-720 (C)	28 (P) 168 (C)
Workshops	37 (P) 7 (C)	1-41 (P) 3-100 (C)	2 (P) 12 (C)	36 (P) 6 (C)	1-150 (P) 36-1754 (C)	28 (P) 334 (C)
Inservice	23 (P) 6 (C)	1-29 (P) 1-60 (C)	2 (P) 3 (C)	23 (P) 5 (C)	1-297 (P) 16-365 (C)	20 (P) 133 (C)
Internship	16 (P) 4 (C)	1-54 (P) 2-12 (C)	2 (P) 3 (C)	15 (P) 4 (C)	1-43 (P) 2-27 (C)	4 (P) 3 (C)
On-line	2 (P) 2 (C)	1 (P) 1-14 (C)	1 (P) 8 (C)	2 (P) 1 (C)	1-1 (P) 200-200 (C)	1 (P) 200 (C)
Other	6 (P) 3 (C)	1-43 (P) 1-31 (C)	9 (P) 13 (C)	6 (P) 3 (C)	10-364 (P) 30-85 (C)	85 (P) 31 (C)

The numbers of participants were also broken down by educational level (i.e., level at which participants were teaching). These data are presented in Table 30 and show that the highest median number of participants is from the secondary school level for projects and 2-year for centers. Additionally, the highest total number of participants is from the associate-degree-granting level. More *projects* report having participants from the associate-degree-granting level as well.

Table 30. Range and Median of Numbers of Participants by Educational Level and Numbers of Projects (P)/Centers (C) Reporting

Educational Level	*Projects* Reporting (n)	Number of Participants (Range)	Number of Participants (Median)
Secondary	40 (P) 8 (C)	2-104 (P) 2-400 (C)	25 (P) 110 (C)
2-year	46 (P) 9 (C)	1-300 (P) 22-1526 (C)	14 (P) 125 (C)
4-year	24 (P) 8 (C)	1-50 (P) 4-82 (C)	10 (P) 12 (C)
Other	11 (P) 3 (C)	1-200 (P) 5-10 (C)	16 (P) 8 (C)

Use of Implementation Strategies

The goal of professional development is for the participants to take home what they have learned and implement it. Table 31 presents the percentages of participants reported by the projects and centers as engaging in various implementation strategies. The highest percentages are found for participants indicating satisfaction with the professional development activity, although all percentages are fairly high. Reported satisfaction of the participants with these efforts is high, which bodes well for implementation. Typically half to two-thirds of this survey's respondents provided data regarding participants' implementation of professional development materials or ideas. These data suggest that half or fewer of the participants tried out technology materials or major ideas in their classrooms and roughly a third incorporated such materials or ideas into their courses or programs.

Table 31. Participant Feedback on *Project* Sponsored Professional Development Activities (Projects (P), Centers (C))

Professional Development Activity	Indicated Satisfaction with the Activity		Indicated Intention to Use the Technology, Materials, And/or Major Ideas Presented		Tried out the Technology, Materials, And/or Major Ideas at Least Once in the Classroom		Fully Incorporated the Technology, Materials, And/or Major Ideas into Their Course or Program	
	Av. %	n	Av. %	n	Av. %	n	Av. %	n
Conferences	82% (P) 93% (C)	26 (P) 7 (C)	70% (P) 90% (C)	23 (P) 7 (C)	55% (P) 29% (C)	17(P) 4 (C)	35% (P) 28% (C)	16 (P) 4 (C)
Workshops	84% (P) 96% (C)	32 (P) 5 (C)	65% (P) 91% (C)	29 (P) 5 (C)	48% (P) 64% (C)	19 (P) 3 (C)	37% (P) 47% (C)	17 (P) 2 (C)
Inservice	97% (P) 35% (C)	21 (P) 2 (C)	79% (P) 35% (C)	20 (P) 2 (C)	48% (P) 3% (C)	14 (P) 1 (C)	29% (P) 2% (C)	11 (P) 1 (C)
Internship	81% (P) 94% (C)	11 (P) 3 (C)	47% (P) 94% (C)	8 (P) 3 (C)	27% (P) 92% (C)	7 (P) 3 (C)	20% (P) 92% (C)	6 (P) 3 (C)
On-line	50% (P) 80% (C)	1 (P) 1 (C)	100%(P) 70%(C)	2 (P) 1 (C)	5% (P) 50% (C)	1 (P) 1 (C)	5% (P) 50% (C)	1 (P) 1 (C)
Other	51% (P) 78% (C)	5 (P) 2 (C)	25% (P) 65% (C)	4 (P) 2 (C)	21% (P) 20% (C)	4 (P) 1 (C)	13% (P) 10% (C)	3 (P) 1 (C)

Notes. Percent values reported in the table cells are averages of percents reported by projects and centers. Reported ns are the number of projects and centers who reported on the professional development activity

Professional development experts (e.g., Guskey, 1999) state (a) that strong professional development requires follow-up from the initial activity (e.g., workshop) to facilitate and support implementation at the institution where the ideas and materials are to be implemented and (b) that the local institution provide support to the implementers in the trial and adoption process. The lower response rates regarding matters of trial and implementation suggest that a large proportion of the *projects* either fail to provide

such follow-up or fail to assess the effects of their efforts. Findings also are mixed on support by the local institutions. Approximately half reported asking for support from the participants' home institutions. In those cases the large majority, approximately 90 percent for associate and secondary, reported that such assistance was provided.

The projects also provide support to their professional development participants. The most common type of support is technical assistance, which was provided by 74 percent of the 58 projects. The next most common was materials, which were provided by 67 percent of the projects. These were followed by money at 45 percent and equipment at 29 percent.

Outcomes of Professional Development

The open-ended item showed that the outcomes reported for institutions at all three levels were very similar with many identical comments. The usual categories were course improvement, knowledge of technology, increased understanding of industry, and opportunity for networking. Table 32 provides a qualitative grouping of the items for the different levels, each with a sample response.

Table 32. Outcomes Categories and Examples of Outcomes Reported by Type of Institution

Categories	Examples
Secondary-More motivating or hands on or project-based classes	Faculty can now implement a hands-on science /technology course that motivates students to study more science and math.
Secondary-Increased understanding of industry	High school teachers attending the summer workshop have a new understanding of roles of technicians and engineers, potential career paths.
Secondary-Working with others or networking	The project provided opportunities for secondary faculty to participate in a variety of workshop experiences and work with community college faculty to integrate and coordinate curricula and programs.
Secondary-Knowledge of technology	As a result of our professional development efforts, faculty can use our educational web site; manipulate data from the site with Excel software, use the data visualization tools and navigate the web site.
Secondary-Articulation	Greater mix of curricula has been obtained. Goal of articulation with counterpart college program has been achieved.
2 year-Knowledge of technology	Faculty have more technical knowledge to upgrade their technology courses.
2 year-Opportunity to improve courses	The project provided the opportunity for faculty to perform back-to-practice activities, attend conference/workshops, participate in curriculum development training seminars, and upgrade their skills and knowledge in their teaching field.
2 year-Networking	Enhanced contacts with peers in other institutions and ability to share information and teaching materials.

Table 32. Outcomes Categories and Examples of Outcomes Reported by Type of Institution	
Categories	**Examples**
2 year-Increased understanding of industry	They gained first-hand experience in various industrial fields and toured all industrial host sites.
4 year-Increased understanding of industry	They are exposed to the latest technology by industry experts and also the expected future technologies. They are able to tour industry locations and see the technology in action. The faculty meet industry people that they can contact for equipment, classroom support visits, remote conferencing recruiting, etc.
4 year-Course improvement opportunity	Educators are better able to administer learning programs on an individualized, competency-based model.
4 year-Networking	… help establish an ATE scholars consortium for their college.
4 year-Knowledge of technology	Create effective web sites to support courses, create multimedia presentations for in-class use, create online courses, create video and audio projects for the internet.

RECOMMENDATIONS/IMPLICATIONS

As noted previously, the primary findings for each category of work provided in this report are largely descriptive and serve as a baseline from which future actions can be tracked and ultimately judged. Additionally, status studies are not intended to be instruments for identifying weaknesses or problems. Yet, they can and often do provide early warning of potential problems. In this study, there appear to be a few indicators that may be problematic in future years if not attended to by the program. The data collected raise some questions regarding *project* efforts to validate their products, whether they are materials developed, programs created or modified, or professional development efforts. Also, the materials receive high use locally, but not at nonproject institutions and relatively little is commercially published for widespread distribution.

There are several things the ATE program can do to address these matters.

1. More directly emphasize validation and dissemination in proposal guidelines.
2. Provide follow-up support to validate materials and/or programs and/or to disseminate validated products.
3. Provide or encourage support systems that foster exchange of information and facilitate the validation processes.

The attention given to development of technicians and the productivity of these *projects* are major strengths of the program. Another major program strength is the high proportion of students taking technician positions and continuing their higher education as a result of *project* programs. The data provided here indicate that the ATE program has successfully engaged associate degree institutions and others in developing materials and programs and providing professional development service to help implement them. Substantial numbers of products in each of these categories are

reported. Importantly, the very large numbers of collaborations between the funded institutions and other collaborators indicates substantial networking focusing on improving the numbers and quality of technicians in the nation's workforce.

REFERENCES

Guskey, T. R. (2000). *Evaluating professional development*. Thousand Oaks, CA: Corwin Press.

APPENDIX

Survey