The Evaluation Center

ADVANCED TECHNOLOGICAL EDUCATION PROGRAM EVALUATION MATERIALS DEVELOPMENT, PROFESSIONAL DEVELOPMENT, AND PROGRAM IMPROVEMENT: PRODUCTIVITY AND QUALITY

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Abstract

This report summarizes the productivity of Advanced Technological Education (ATE) grantees regarding three major aspects of the ATE program, program improvement, materials development, and professional development. Drawing from annual survey data, the study's findings show substantial evidence of grantee productivity and strong conviction on the part of principal investigators that they have done work of high quality. The claims of quality are considered against other indices of quality as well as ATE solicitation expectations for evaluations of merit. The authors argue that principal investigators' claims of high quality can and should be buttressed by stronger evidence and that the program's annual solicitations for grant proposals have steadily improved the guidance to grant developers.

The 2006 Briefing Papers are prepared from survey census data collected in February and March 2006 from principal investigators (PIs) of ATE projects and centers.[1] Each surveyed project/center was currently funded by the ATE program and had been funded for at least one year prior to the survey. The response rate for this survey was 92 percent (163 of 178 grantees in the sample). Only grantees that were significantly engaged in materials development, professional development, or program improvement were required to complete survey sections dedicated to these specific activities. For centers, the criterion for significant engagement was that ≥ $100,000 of their direct costs in the past 12 months was allocated specifically for that activity. For projects, the criterion was that ≥ 30 percent of their direct costs was allocated specifically to the activity.

1. CENTER AND PROJECT ENGAGEMENT IN ATE CATEGORIES OF WORK

This brief focuses on ATE PIs' reports of productivity; their perceptions of the quality of their products and efforts; and their quality assurance steps in terms of materials development, professional development, and program improvement. The above-stated criteria for completing these three sections of the survey are stringent and require that the project or center be substantially engaged in the designated programmatic effort.

In all, 72 percent of the PIs reported that their center or project was significantly engaged in at least one of the three main areas of ATE work: materials development, professional development, and/or program improvement. Table 1 summarizes project and center engagement in individual types of activity. Figures 1 and 2 provide a more complete view of the two populations that are heavily engaged in individual activities and combinations of activities.

Table 1.
Percent of Projects and Centers
Engaged in ATE Program Activities

Program Activity	Projects	Centers	Total
Materials Development (MD)	36%	29%	34%
Professional Development (PD)	38%	49%	40%
Program Improvement (PI)	38%	51%	41%
At least one of the three designated activities	75%	68%	72%

Together Table 1 and Figures 1 and 2 show five main characteristics:

- Slightly more than a third of the projects significantly engage in each of the three activities
- About half of the centers engage in professional development (PD) and program improvement (PI), respectively, but fewer than a third engage in materials development

[1] This briefing paper is based on survey data from the 2006 survey of ATE projects and centers. For a description of the survey's sampling method, response rates, and overall findings, refer to the *Advanced Technological Education Program Fact Sheet* (Coryn, Ritchie, & Gullickson, 2006), *ATE Indicators of Productivity: Six-Year Trends 2000-2005* (Gullickson, Coryn, & Hanssen, 2006), and *2005 ATE Technical Report: Processes, Procedures, and Results* (Coryn & Hanssen, 2005).

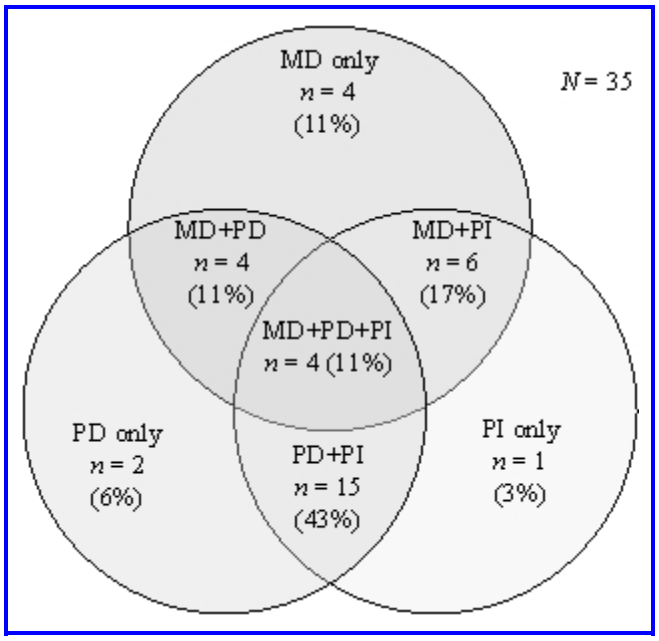

Figure 1.
Center Engagement in ATE Work Activities

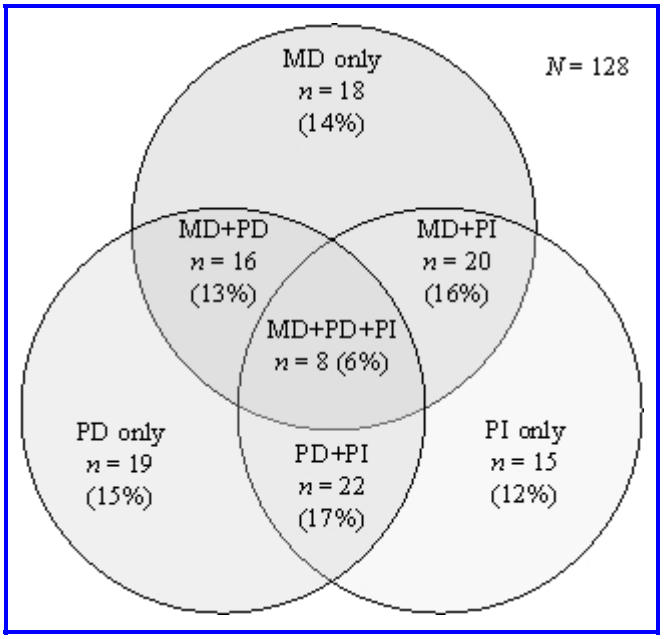

Figure 2.
Project Engagement in ATE Work Activities

- Consistent with the first two points, Figures 1-2 show that a much higher proportion of centers simultaneously engage in PD and PI than is true for projects
- Large proportions of projects (41%) and centers (48%) engage in more than one of these activities
- It is unusual for a center to be significantly engaged in all three activities (about 1 in 10) and very unusual for a project to engage in all three (about 1 in 20)

2. MATERIALS DEVELOPMENT

The 80 grantees who met the definition for inclusion in the materials development sample reported producing large numbers of materials aimed directly at serving technician education purposes in associate degree and other education settings. PIs reported a total of 698 materials under development in the previous 12 months. This is an average of more than 12 materials items per grantee. Of the total 263 (38%) were in draft stage, 177 (25%) were being field-tested, and 258 (37%) were completed.

Nearly half the materials (48%) were being developed for use at the associate degree level, 15 percent for secondary schools, and 11 percent for baccalaureate programs. More than a quarter (26%) of these materials were designated for other uses that likely crossed multiple education levels.

The ATE annual grant solicitation (National Science Foundation, NSF 05-530, 2005) stipulates that materials developed by funded centers and projects must be prepared for national dissemination and should "affect the learning environment, course content, and experience of instruction for students preparing to be science and engineering technicians and for their teachers" (p. 6).

PIs indicated that 4,000 institutions other than their own were using at least 1 material developed with ATE support. These materials are being distributed in 5 major forms. As Table 2 shows, centers prepare the large majority of their materials in print form. Projects tend to be more eclectic in their choice of distribution mode. Projects especially are much more likely than centers to prepare materials in formats for "Online/Web-based training."

Table 2.
Distribution Mode of Grantee Produced Materials

	Centers	Projects	Total
Print (e.g., textbooks, manuals)	72%	43%	48%
Audio/video (e.g., cassettes, videotapes, one media only)	7%	8%	8%
CD-ROMs (e.g., may include video, audio, text, or a combination)	6%	10%	10%
Online/Web-Based Training (Web CT, online self-paced learning, etc.)	12%	27%	25%
Mixed media (e.g., textbooks with supporting CD-ROM)	2%	12%	10%

Both center and project PIs rated the quality of the materials that they developed in the past 12 months as "very good" to "excellent" (centers $M = 4.44$, $SD = 0.52$;

projects M = 4.34, SD = 0.56).[2] Table 3 provides supporting information that suggests centers and projects rely very heavily on content validation for their strong assessments of quality. Both groups indicate their use of applicable standards, but centers more than projects gather input regarding workforce needs to guide development of materials and verify the alignment of the materials with those needs (points A-C). Both groups tend to field-test their materials within the confines of the institutions, but much smaller proportions actually confirm the viability of their materials through final student performance assessments based on instruction using those materials (points F-G). When viewed from a more strict criteria basis of *always* taking the respective steps, the points above stand out more strongly.[3] Under these strict conditions, ATE grantees state that, on average, they always use 5 of the 7 listed methods (centers, 6; projects slightly less than 5).

Table 3.
Extent to Which Centers and Projects
Apply Quality Assessments to Materials Development

	Centers		Projects	
	M	*SD*	*M*	*SD*
A. Gather input from business and industry regarding workforce needs	4.56	1.01	3.66	1.42
B. Use applicable student and industry standards or guidelines	4.11	1.36	4.15	0.93
C. Verify and validate alignment of materials with industry needs	4.44	1.01	3.76	1.22
D. Field-test materials internally	4.11	1.05	4.27	1.14
E. Field-test materials externally	3.89	1.26	3.58	1.41
F. Assess student success in comparison with industry standards	3.11	1.61	2.92	1.54
G. Assess improvement of student performance in the workforce	2.89	1.53	2.68	1.66

Note. 1= never used, 2 = seldom used, 3 = used about half the time, 4 = used most of the time, and 5 = always used.

Points F and G in Table 4 clearly show that the large majority of current grantees fall short of the ATE 2005-2006 guidelines requirements for materials developers: "Evaluation must include measures of increased student learning of content and processes and have input from employers" (NSF 05-530, p. 6). Because that requirement was stipulated for the first time in 2005, none of the currently surveyed grantees must meet those expectations. Certainly, however, future PIs must plan and budget more directly for this major undertaking.

[2] Where 1 = poor; 2 = fair; 3 = good, average; 4 = very good; and 5 = excellent.
[3] "Always" applying a particular assessment strategy was chosen as a point of reference because it is more reliable (i.e., "used most of the time" is subject to interpretation, "always" is not).

Table 4.
Proportion of Centers and Projects that "Always"
Apply Materials Development Quality Assessments

	Centers *P*	Projects *P*
A. Gather input from business and industry regarding workforce needs	70%	35%
B. Use applicable student and industry standards or guidelines	50%	35%
C. Verify and validate alignment of materials with industry needs	60%	30%
D. Field-test materials internally	40%	57%
E. Field-test materials externally	40%	35%
F. Assess student success in comparison with industry standards	30%	15%
G. Assess improvement of student performance in the workforce	20%	20%

3. Quality of Centers' and Projects' Professional Development Activities

Professional development, as described by ATE (National Science Foundation, NSF 05-530, 2005), should provide "current secondary school teachers and college faculty with opportunities for continued professional growth in areas that directly impact technician education . . . [and] . . . should be designed to enhance the educators' disciplinary capabilities, teaching skills (including skills in using information technology and other educational technologies to enhance instruction), vitality, and understanding of current technologies and practices" (p. 7). Sixty-six ATE PIs indicated that they were significantly engaged in providing professional development opportunities for current and/or prospective college faculty and/or secondary school teachers. Combined, they reported offering 1,136 professional development activities that were attended by 13,858 participants of which 38 percent (5,265) were at the secondary school level, 40 percent (5,575) at the associate level, and 22 percent (3,018) at the baccalaureate level.

Overall, two-thirds of professional development opportunities offered by grantees were events (66%), with the remaining third consisting of events with follow-up activities (12%), long-term contact programs (11%), internships (4%), and self-study programs (8%). The large majority of both center and project PIs (88% and 77%, respectively) reported that their professional development activities are best described as supporting their "broader ATE objectives (i.e., program improvement, materials development, development of articulation agreements)" as opposed to being "stand-alone activities not necessarily linked or integrated with other ATE activities."

On average, centers and projects rated the quality of their professional development activities in the past 12 months as "very good" to "excellent" (centers $M = 4.69$, $SD = 0.47$; projects $M = 4.35$, $SD = 0.67$).[4] Center PIs much more than project PIs rated the quality of their professional development activities as "excellent" (69% and 46% respectively). These ratings appear to be substantiated primarily by end-of-program reaction data.

As shown in Tables 5 and 6, centers and projects tended to gather end-of-program reaction data and follow-up data to determine implementation and adoption of professional development ideas. Fewer followed up to trace impact on students when these ideas were implemented. Of the five methods used for assessing the quality of professional development activities, ATE grantees used fewer than four on average; centers used four, and projects used approximately three.

Table 5.
Extent to Which Centers and Projects Apply Quality Assessments to Professional Development Activities

	Centers		Projects	
	M	*SD*	*M*	*SD*
A. End-of-program reaction data	4.56	0.62	4.47	1.05
B. Follow-up data to determine implementation/adoption of ideas	3.81	1.27	3.91	1.20
C. Follow-up data to determine impact of implementation on student achievement	3.13	1.45	3.09	1.31
D. Feedback from instructional experts regarding content and instruction	3.38	1.45	2.47	1.57
E. Expert panel review of professional development activities and/or products	2.44	1.45	2.21	1.47

Note. 1= never used, 2 = seldom used, 3 = used about half the time, 4 = used most of the time, and 5 = always used.

Table 6.
Proportion of Centers and Projects that "Always" Apply Professional Development Quality Assessments

	Centers	Projects
	P	*P*
• End-of-program reaction data	60%	65%
• Follow-up data to determine implementation/adoption of ideas	41%	35%
• Follow-up data to determine impact of implementation on student achievement	24%	12%
• Feedback from instructional experts regarding content and instruction	24%	16%
• Expert panel review of professional development activities and/or products	12%	14%

[4] Where 1 = poor; 2 = fair; 3 = good, average; 4 = very good; and 5 = excellent.

The *National Science Education Standards* (NSES) (National Research Council, 1996) outline the characteristics of quality professional development programs at all education levels. They set forward four standards for professional development efforts, stating that professional development for science teachers

A. Requires learning essential science content through the perspectives and methods of inquiry
B. Requires integrating knowledge of science, learning, pedagogy, and students; it also requires applying that knowledge to science teaching
C. Requires building understanding and ability for lifelong learning
D. Must be coherent and integrated

The 26 guidelines for these standards expand on those 4 ideas to elaborate and emphasize such matters as the importance of designing professional development, not just to impart technical skills, but also to deepen and enrich understanding and ability. Both the guidelines and associated text contend that, to be successful, professional development "must extend over long periods and include a range of strategies to provide opportunities for teachers to refine their knowledge, understanding, and abilities continually" (National Research Council, 1996, Chapter 4).

The work of ATE grantees appears most vulnerable to falling short of NSES standards in the length (extent) of time for professional development efforts. The one-time or short-term events that are conducted by nearly two-thirds of grantees seem unlikely to provide the necessary period of engagement and support structure to help teachers refine their knowledge, understanding, and abilities.

At the same time, information gathered from the survey suggests that ATE professional development efforts do focus on the second and fourth NSES standards (B and D). PIs clearly stipulate that their professional development work is intended to support broader ATE objectives and not "stand alone."

4. Program Improvement Efforts

Program improvement is intended to "increase the relevance of technician education to modern practices and assure an increased number of students entering the high performance workplace with enhanced competencies" (NSF 05-530, National Science Foundation, 2005, p. 6). Sixty-seven ATE PIs reported that they were significantly engaged in improving their

courses or programs, where "programs" were a series of courses designed to lead to a specific degree or certification and "courses" were components of programs. These PIs indicated that they were developing or improving 302 programs at 283 locations, consisting of 956 courses and serving 28,200 students. As Table 7 shows, the large majority of this work was located at associate degree institutions and created to serve students at that level.

Table 7.
Key Descriptors of ATE Program Improvement Efforts

	Education Level				
	Secondary	Associate	Baccalaureate	On-the-Job	Total
Programs	57	197	21	27	302
Locations	61	165	23	34	283
Courses	52	790	60	54	956
Students	2,719	23,913	289	1,279	28,200

The ATE guidelines (National Science Foundation, NSF 05-530, 2005, p. 5) set forward seven requirements, including expectations that the program improvement efforts will produce enhanced curricula; involve employers; produce an improved program that leads students to an appropriate degree, certification, or occupational competency; increase the pool of skilled technicians; and induce an increased proportion of students who enroll to complete programs. Though stated somewhat differently from year to year, these expectations have been evident for the past several years. As such, they form the basis from which one would expect PIs to form their overall judgments of program improvement quality.

On average, centers and projects rated the quality of their program improvement efforts in the past 12 months as "very good" (centers $M = 4.33$, $SD = 0.39$; projects $M = 4.40$, $SD = 0.49$).[5] Less than a majority, 33 percent of centers and 40 percent of projects, rated the quality of their program improvement efforts as "excellent." Unlike both materials development and professional development, centers rated the quality of their program improvement efforts lower than projects did.

Of 11 options offered to PIs as methods used for assuring the quality of program improvement efforts, the individual PIs reported about half. This varied slightly from projects to centers, with projects using about 6 and centers using about 5.

As Tables 8 and 9 show, project PIs are much more likely to assess program improvement efforts at the classroom level. Neither group reported extensive postprogram follow-ups with either students or employers.

Table 8.
Extent to Which Centers and Projects Apply Quality Assessments to Program Improvement Efforts

	Centers		Projects	
	M	*SD*	*M*	*SD*
Course-level student satisfaction data	3.55	1.12	4.17	1.18
End-of-program student satisfaction data	3.50	1.17	4.03	1.35
Student course grades	3.09	1.30	4.17	1.27
Data regarding student dropout rate	3.18	1.25	3.45	1.48
Data on student or industry referrals to the program	2.18	0.98	3.06	1.43
Postprogram follow-up data from students (e.g., employment status, preparedness for industry)	2.50	1.08	2.94	1.41
Postprogram follow-up data from supervisors of students (e.g., skills, knowledge preparedness for industry)	2.30	1.16	2.91	1.37
Testing of students against established business/industry work standards	2.91	1.13	3.03	1.58
Comparison of students' knowledge and skills against other critical competitors (e.g., other colleges or military programs or other course options)	2.09	0.83	2.49	1.52
Feedback from instructional experts regarding content and instruction of courses and program (e.g., comparisons of program content and instruction against critical competitors)	3.20	1.13	3.53	1.39
Expert panel review of program and/or products	3.45	1.12	3.22	1.45

Note. 1= never used, 2 = seldom used, 3 = used about half the time, 4 = used most of the time, and 5 = always used.

The 2006 survey was not created to address all the criteria specified by ATE for program improvement directly. However, the materials development previously described shows that centers are more likely to seek input from business and industry in developing materials (e.g., courses). Also, most PIs could easily describe what they have done to create a new program or enhance a current one. So, lack of assessment actions identified is not a clear indication of failure to address quality matters. Yet, several

[5] Where 1 = poor; 2 = fair; 3 = good, average; 4 = very good; and 5 = excellent.

Table 9.
Proportion of Centers and Projects that "Always" Apply Program Improvement Quality Assessments

	Centers *P*	Projects *P*
Course-level student satisfaction data	6%	37%
End-of-program student satisfaction data	6%	35%
Student course grades	6%	41%
Data regarding student dropout rate	11%	22%
Data on student or industry referrals to the program	17%	14%
Postprogram follow-up data from students (e.g., employment status, preparedness for industry)	11%	8%
Postprogram follow-up data from supervisors of students (e.g., skills, knowledge preparedness for industry)	17%	8%
Testing of students against established business/industry work standards	6%	16%
Comparison of students' knowledge and skills against other critical competitors (e.g., other colleges or military programs or other course options)	17%	8%
Feedback from instructional experts regarding content and instruction of courses and program (e.g., comparisons of program content and instruction against critical competitors)	11%	20%
Expert panel review of program and/or products	17%	16%

points suggest that improvements can be made. Follow-up of students is one important area; direct assessment of students against industry standards is another. Certainly, if the program is expected to be a model for dissemination, external review by experts is essential as a step toward assuring that the program is strong and suitable for use in other locations.

5. Overall Conclusions and Recommendations

Four general points surface in this paper: two regard the PIs' responses, and two devolve from the ATE program solicitation. First, in each of the three targeted areas, productivity of the grantees is quite large. The amounts of materials, courses, and programs being created and disseminated as well as the numbers of students and professional development participants instructed are all large. This large productivity, we believe, provides a necessary but not sufficient basis for arguing that the ATE program is successful. For example, none of the ATE criteria (as provided in the annual solicitations) specify the amount produced as a criterion for success—not in productivity of materials, professional development activities, or courses and programs created or changed. Along with substantial productivity, evidence of good quality is a requisite determiner of success.

Second, the findings show very strong PIs' self-reports regarding the quality of their work—they consistently reported that their work products were very good to excellent. While the reliability of those measures is apparent in both this year's survey findings and through comparison of findings across years, the validity of those findings is more open to question. Of special concern is the fact that PIs' self-interests are served by their positive reports.

On the one hand, if the PIs were not satisfied with their products and productivity, there would be cause for concern. Certainly, no project or center was funded to be minimally productive or to develop just "okay" products. Also, PIs do not get to be PIs by detracting from their own work. So, these high self-ratings were expected.

On the other hand, high ratings of self-efficacy need to be buttressed by strong supporting evidence—stronger than were evident in the survey findings. Too often PIs indicated that they were not always gathering the data requisite for complying with ATE expectations or for confirming their self-ratings of success.

Third, we noted in sections 2 and 4 that ATE requirements for establishing the relative merits (quality) of project work have gotten stronger across time. Even in a single year, from 2004 to 2005, strengthening of the specifications can be seen. These criteria now make demands on projects that go well beyond the creation of materials, conduct of professional development activities, and changes to ongoing technician programs or creation of new ones. They must produce real, verifiable evidence of quality.

Yet, solicitations remain quite vague as to what constitutes viable evidence of quality. For example, PIs likely will ask questions such as, What constitutes adequate evidence of student learning, or How will I know whether this model for program development is good enough to be disseminated?

Fourth, the solicitations' increased expectations for establishing quality of grant products tend to underline the fact that PIs fall short in their assessments of quality. Here survey findings consistently point to ways that projects and centers can do more to assure quality and to

produce real, verifiable evidence of quality. For example, more projects that do materials development work need to engage business and industry stakeholders in determining materials' content. Similarly, providers of professional development, projects and centers alike need to develop long-term processes to serve participating teachers. All centers and projects need to build assessment practices into their development work that both help them do the best possible job in creating high quality work products and ultimately establish the quality and worth of their products.

All of this sums up to two general statements:

1. There is substantial evidence of strong ATE productivity.
2. Available evidence regarding the quality of ATE work and products, while strongly positive, has a weak validity foundation.

We applaud the continual progression of solicitations to strengthen expectations for quality. We encourage continual improvement in ATE efforts to both require and assist PI efforts to improve the validity underpinnings for their work.

Solicitations certainly are a first point of engagement with PIs. Greater specificity of requirements tends to improve validity. So, it may improve matters if the ATE solicitation provides a bit more elaboration or further clarification of expectations. For example, the solicitations call for professional development projects to span two years to effect long-term changes. Inherent in that statement is the expectation that it is not sufficient that the professional development work last two years; the *same* participants need to be actively engaged for that span of time. Coupled with these small elaborations, we encourage more direct identification of strong support materials such as the NSES standards that can help guide grantees in designing their work.

Solicitations are not, however, the only point of engagement between the ATE program and PIs. Some of the other points include the annual PI meeting and technical support provided through special grants. Centers have received much more technical assistance support than projects here. For example, in November 2005 the ATE program held an invited conference for centers and their evaluators to address matters of evaluation. Centers also have support for a newsletter, have had a meeting of institution presidents, and received support for engagement in the annual conference of the American Association of Community Colleges.

While we do not argue that ATE's objective is professional development, it is clear that ATE's avowed purposes call for professional development types of engagement with grantees. For example, the first stated purpose of the Congressional Act of 1992 was to "improve science and technical education at associate-degree-granting colleges" (Scientific and Advanced-Technology Act of 1992, § 2). We encourage the ATE program itself to use tools such as the NSES standards for professional development to increase and improve its strategies for practically, cost-effectively, and regularly engaging PIs (projects as well as centers) in opportunities to refine their knowledge, understanding, and abilities to achieve high quality outcomes and valid assurances of the quality of their work.

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