The Sustainability of Advanced Technological Education Supported Efforts: An Evaluation

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The Sustainability of Advanced Technological Education Supported Efforts: An Evaluation

by

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“If you build it, they will come.” (*Field of Dreams,* 1989)

“One of my students . . . in [her] doctoral dissertation, looked at the residual impact of the three-year NSF grant that I had. She found:

1. Relatively few projects do long-term residual impact [studies] of their effects.

2. The long-term residual impact of my NSF project was not nearly as large as I would have expected or desired.” Moursund, D.G. (1989, Revised 2005)

Abstract

This report addresses the ways and extent to which Advanced Technology grantees sustain project-level efforts after funding by the National Science Foundation ended .

ATE grantees whose projects were completed in 2004 or before were identified and surveyed. Responses were received from 136 of 172 grantees for a response rate of 79 percent. Five targeted aspects of productivity and two factors considered integral to the continuation of project work were addressed. These included courses, curriculum, professional development, materials development, articulation, collaborations with other entities (e.g., business and industry) and continuity of funding support.

After completion of ATE funding, productivity declines were reported in two of the five targeted areas, professional development and materials development. Near “steady state” continuity was reported for the remaining three areas of course, curriculum, and articulation agreements. The number of collaborations and the amount of funding support available to the grantees declined substantially following completion of ATE funding. These findings describe a pattern that one might logically expect. That is, areas of work that can be conducted within faculty members’ job expectations and do not required additional funding tend to be continued. Those that require continuous funding tend to decline substantially when that funding ceases. The need for additional study to assess long-term impact of professional development efforts and materials development efforts was noted.

Created under the auspices of the Congressional Act of 1992, the Advanced Technological Education program (ATE) is a long-term effort by the federal government to improve the education of technicians at the undergraduate and secondary levels. The program focuses on two-year colleges but calls for collaboration of those colleges with high schools, four-year colleges and universities, business, industry, and government.

Evaluation work by The Evaluation Center at Western Michigan University documented across a six-year span that the ATE program has funded and supported major efforts to achieve these goals. These reports [e.g., *ATE Indicators of Productivity:Six-Year Trends 2000-2005* (2006)] show substantial productivity by funded projects (i.e., projects and centers) in terms of collaborations, professional development, program improvement, materials development, and other achievements. Clearly, the foundations for change have been laid in the many locations where the ATE program has provided funding support.

Realizing the goals of the Congressional Act means that work, productivity, initiated under auspices of these grants must continue beyond the funding time frames of the grants. This means that the collaborations, professional development, program improvement, materials development, and other achievements that were documented for the ATE program must carry forward, be sustained, by the organizations and institutions that received ATE funding support. It is one thing to anticipate that intended programs and educational activities will continue after funding ceases, it is another to actually continue them.

The notion of sustainability is widely used in a variety of ways, especially in consideration of what happens upon completion of funded grant work. Often sustainability carries with it an interest or concern for continuity of things generated during a grant, including for example, the ideas taught or learned, the persistence, institutionalization, of programs developed as part of a grant, or even dissemination of materials created in the course of the grant. For some, sustainability is viewed as residual impact–what remains once the project funding has completed.

Many project directors assume, after spending three years and thousands of dollars, that their efforts will endure. That, however, may not be the case. Moursund (see preface) was surprised to find there was little residual impact of his NSF-supported grant. As long time NSF project evaluators, we are not surprised. In fact, as consultants, we sometimes ask proposal writers, "What are you doing to ensure the *Field of Dreams* assumption?" That is, how do you know that after you develop a course or a professional development experience, "they will come!" This forces them to consider the life of their project after funding ends.

In this report we focus on several aspects of sustainability–-continuity of effort after NSF funding comes to an end and "stability" of component elements intended to serve those efforts. Our rationale for this focus is based upon the expectation that real, long-term changes require such continuity of effort if the ideas, materials created, and lessons learned, during the life of the grant are to be embedded in and improve education at the funded institutions. We note that this study does not address a number of important aspects of sustainability such as continuity of ideas and the broad effects of professional development that impact both individuals and the many institutions that participated in the funded grant work.

To address sustainability we provide a brief overview of the ATE program, outline an evaluation plan, describe the methods used to conduct the study, and describe the extent of sustainability

using several indicators. These include perceptions of productivity by project directors, persistence of collaborations, post-project financial support, and adoption of work products at their and other institutions.

The Advanced Technology Education Program

The ATE program grew out of a concern for better ways of developing and using technology to meet the nation's needs. The importance of technological education initiatives is explained in two documents: *Technology for All Americans: A Rationale and Structure for the Study of Technology* (International Technology Education Association, 1996) and *Gaining the Competitive Edge: Critical Issues in Science and Engineering Technician Education* (National Science Foundation, 1993). These documents explain the important need this country has for well-trained professional technicians.

In response to the national concern, Congress passed *The Scientific and Advanced Technology Act of 1992.* The Act set forward the purposes that serve as the foundation for the ATE program:

1. improve science and technical education at associate-degree-granting colleges

2. improve secondary school and postsecondary curricula in mathematics and science

3. improve the educational opportunities of postsecondary students by creating comprehensive articulation agreements and planning between 2-year and 4-year institutions

4. promote outreach to secondary schools to improve mathematics and science instruction

The National Science Foundation initiated the Advanced Technological Education program to address the Congressional mandate, and the first awards were made in the summer of 1994.

By fall 2004, the ATE program had provided more than $321 million to 609 ATE projects and centers to support education in a broad range of technology fields, such as biotechnology, chemical technology, computer and information technology, electronics, environmental technology, geographic information systems, manufacturing, and telecommunications.

ATE funds mostly two-year colleges to develop materials for technical education, improve their technical program of instruction, and provide professional development to faculty and teachers. In these efforts, projects are expected to collaborate with business, industry, and education partners.

Evaluation Plan

The goal of evaluation is the systematic determination of the merit or worth of an object. Here, the object of interest is the ATE program as it was manifested by the work of 600 awards. One might use several criteria to determine value, for example, increased numbers of competent technicians in the workforce. However, in this study, the criterion of interest is the survival—that is, the continuity of the "stream of work" initiated under the auspices of the ATE grant. This work

effort could include continued efforts to develop, use, and disseminate things such as the programs, courses, curricula, trained professionals, materials, alliances, and knowledge generated by the projects. ATE grants were made to accomplish these tasks. A brief description of these tasks follows (see Table 1).

Table 1. Descriptions of Funding Categories: ATE Grants

Category	Description
Courses	Intact educational experiences for which a student may receive credit toward a degree or certificate.
Curriculum	A series of courses or experiences that leads directly to a degree or certificate program.
Professional Development	Projects that provide current secondary school teachers and two-year college faculty with opportunities for professional growth in areas that directly impact advanced technological education.
Materials Development	Textbooks, laboratory experiments and manuals, software, CD-ROMs, videos or other courseware that will be published for national distribution to colleges, secondary schools, or industry.
Articulation Agreements	Partnerships between two-year colleges and four-year colleges and universities to develop in-service programs for prospective teachers and provide opportunities for two-year college students to continue their education at degree-granting institutions.
Research	Studies that assess the effectiveness and impact of efforts to enhance technician education to ensure the ATE program and its projects are grounded in research.

Evidence of the continuation of the ATE work is important to the program stakeholders, Congress, the National Science Foundation, community colleges, and technicians. This would help provide information to justify the program and, perhaps, offer clues on ways to improve sustainability. Hence, the general purpose of this study is to assess whether or not ATE projects are sustained and, if so, to what extent.

Indicators of sustainability include the continued development and use of courses, curricula, and materials; ongoing professional development activity; and the persistence of the collaborations and articulation agreements established during the life of the grant. Five questions were identified to guide the evaluation:

1. Is project productivity continued after funding ceases?
2. Do the collaborations established by the projects persist after funding ends?
3. Does the level of support, both direct and in-kind, change after the project ends?
4. What is the extent of adoption of project work products by other institutions?
5. What was learned in this evaluation that has implications for improving sustainability of NSF-supported projects?

The information necessary to answer these questions was obtained from a PI survey and the NSF database of all past and current ATE awards (N=609.) This process is explained in the next section.

Method

A list of all past and current ATE awards was obtained from the NSF Web site. A total of 609 awards was made between 1994 and 2004. Most of these were single grants, usually for 3 years' duration. However, approximately a fifth of the projects received a second award to continue the first grant's work; and occasionally, 3 and 4 grants were made to the same site, continuing the stream of work started with the initial grant. (This was common in the centers that were larger, multifocused and long-term efforts to improve technology education.) The total number of sites that received 1 or more awards was 438.

The sample chosen for the study was restricted to ATE sites whose funding ended before September 1, 2004. This meant that grantees were included who received funding support between 1994 and 2004. Two hundred four (204) sites met the inclusion criteria. Of the 204 sites, NSF-based contact information was not available for 65 awardees. Telephone follow-up calls identified 33 names, but we were unable to obtain access information from 32. This produced 172 viable contact sites.

The contact people (mostly former project directors or principal investigators) of these ATE projects were asked to complete an online survey. Question development was based on the project's earlier review of the literature (Lawrenz & Keiser, 2002), inspection of the ATE monitoring and evaluation data maintained by The Evaluation Center at Western Michigan University, prior work on sustainability issues (Lawrenz & Kaiser, 2002), and the advice of an external advisory committee.

The survey included demographic questions, a set of questions about collaborations between the grantees and other organizations and institutions, and six sections about the tasks of the ATE program. Respondents were asked to answer the background and collaboration questions and then to pick two tasks of their project that described their primary work efforts. Additional questions were asked about these two targeted tasks.

Two rounds of pretesting the instrument were carried out using potential respondents. The first round was a "paper and pencil" review that focused on the questions themselves. The intent was to assure that content was appropriate and useful. A second round of testing involved a prototype online version of the questionnaire. The survey can be found at http://www.wmich.edu/evalctr/ate.

The survey was first administered to 172 sites in April 2005. Several follow-up e-mail and telephone contacts were made, and all data were included that had been received by June 3, 2005. Eventually, 136 complete surveys were received for a response rate of 79 percent.

Sample characteristics. The 136 awards varied considerably in size and purpose. They include planning grants, focused projects, and centers expected to be comprehensive in scope. Funding ranged from $30,000 for a planning grant to $5,000,000 for the support of an ATE center. The average award amount was $605,932 and the median award was $450,000. The projects in the sample received a total of $82,406,774.

The median length of NSF support was 4 years. There were 128 project sites and 8 centers. Most sites (n=111) received 1 award, while 21 sites received 2. Two sites in the sample received 3 grants, and 2 others received 4.

The ending dates of the projects ranged from 1995 to 2004. The frequency of the end years is shown in Table 2.

The oldest project in the study ended in August 1995. It was a 1-year grant of $49,963 to develop a curriculum for biomedical electronic technicians in Houston, Texas. The most recent grant ended its funding in August 2004. This was a 3-year award of $787,278 to develop instructional materials in information technology.

The average ending year of the grants in our study was in 2001. The average time between the end of a grant and the completion of the survey was 3.9 years. The range was 9 months to more than 9 years.

Table 2. Ending Year of NSF/ATE Support

NSF Funding Ends	Frequency
1995	1
1996	5
1997	9
1998	12
1999	11
2000	22
2001	13
2002	20
2003	17
2004	26
Total	136

Nonresponse bias. Responses were received from 136 of the 204 eligible projects. We were unable to identify or obtain contact information for 32 of them, and another 36 did not reply despite several follow-up contacts. There were a variety of reasons including resignation or retirement from the college, study leaves, failure to obtain a telephone contact, and an unwillingness to take the time to answer another survey.

We assessed differences between the 136 contact people who responded and the 68 who did not by comparing them on several variables available in the the grants database. We selected

three variables for comparison purposes: average grant size, duration, and time since funding ended. Results of these comparisons are shown in Table 3.

Table 3. Grant Characteristic Between Respondents and Nonrespondents

Variable	Respondent Group (N=136)	Nonrespondent Group (N=68)	Difference (Col. 2 - Col. 3)
Size of grants	$607,000	$356,000	$251,000
Time elapsed since grant ended	3.9 Years	4.5 Years	- 0.6 Years
Length of grant	3.8 Years	2.9 Years	0.9 Years
Note. Cells contain mean values and all dollar values are rounded to the nearest thousand.			

As the table shows, respondents received larger grants, were funded for longer periods of time, and more recently completed their projects. These differences all favor conditions that likely produce more sustainability for respondents than non respondents. Based on findings from our analyses of survey data, we suspect but cannot be certain that our findings for sustainability slightly overstate what would have been the case if all sampled projects had responded. This means that the that generalization to ATE grants in general should be made with caution. We encourage use of this study's findings for identifying areas of inquiry about other NSF-funded programs, but we make no assertions that sustainability of projects occurs in other programs in the same way(s) that it occurs for ATE.

Findings

Five evaluation questions were posed that address the issue of sustainability:

1. Is project productivity continued after funding ceases?
2. Do the collaborations established by the projects persist after funding ends?
3. Does the level of support, both direct and in-kind, change after the project ends?
4. What is the extent of adoption of project work products by other institutions?
5. What was learned in this evaluation that has implications for improving sustainability of NSF-supported projects?

Was productivity sustained? Productivity refers to grantee success in achieving the tasks it was funded to do. This includes the development of courses, curricula, and materials that are used by students; the professional development of faculty and teachers; and students who are involved in articulation agreements between two-years colleges, schools, and four-year colleges.

Several questions on the survey asked respondents to judge the changes in productivity after funding ended. These kinds of questions are fraught with potential response bias, i.e., the desire of the project directors to make their work look good. However, they do provide a perceptual indicator of sustainability.

Respondents were asked about changes in the numbers of students enrolled in new courses and curricula and those that articulated under the newly established articulation agreements. They were also asked about changes in the number of faculty enrolled in new professional development programs and the number of copies of new materials that were distributed.

Changes in productivity were assessed during the first year after funding stopped and for the duration between 2004-05 and the project end date. There was some overlap in responses for projects that ended in 2003 or 2004. The actual wording of the questions is shown in Table 4.

These phrases were used to fill in the blank for each of the five tasks:

> Course development --- "the number of students enrolled in the courses developed with ATE support" ---
>
> Curriculum development --- "the number of students enrolled in the curriculum developed with ATE support" ---
>
> Professional development --- "the number of faculty enrolled in the professional development programs developed with ATE support" ---
>
> Materials development --- "the number of copies you distributed of materials you developed with ATE support" ---
>
> Articulation agreements ---- "the number of students who articulated under the agreements you developed with ATE support" ---

Table 4. Productivity Rating Questions

	Decreased a Lot (>20%)	Decreased a Little (10%)	Stayed the Same	Increased a Little (10%)	Increased a Lot (>20%)	Don't Know
In the year immediately after your ATE funding ended, how did _____ change?						
As of the 04-05 academic year, how has _____ changed since your final year of funding?						

Respondents were asked to estimate the change on a 5-point scale ranging from "Decreased a lot, more than 20 percent," to "Increased a lot, more than 20 percent." Accurate responses to these questions would be difficult to determine, so the responses are treated only as rough estimates. The responses were coded from a -2 to a +2 on the 5-point scale. A judgment of no change or "stayed the same" was coded zero.

Recall that respondents were asked to pick just 2 of 6 possible tasks. In addition, not all projects carried out all tasks so the number of replies for each response is less than 136, the total number of surveys returned. For the productivity questions, the number of responses

ranged from 66 for the course development task to 17 for students enrolled in articulated programs.

The perceived changes for the five ATE tasks are shown in Table 5. Mean differences were tested to see if the changes were significantly non-zero. This was done for one year after the project ended and also for 2004-2005.

A sustained project would be one that stayed the same or increased. The mean change would be zero or a + value. Productivity that declined would show negative mean changes. In the year following the end of the project, productivity either "Stayed the Same" or "Increased a Little" for all tasks but Professional Development. This activity was thought to have "Decreased a Little, about 10%."

Table 5. Perceived Productivity Change by ATE Task
(One Year After and Between Project End and 2004-05)

Scale range (-2.00 to +2.00)

Task	*Elapsed Time*	*Sample Size*	*Mean Change*	*t-test*
Course Development	One year	66	0.32	2.12*
	Since project ended	61	- .03	-.19
Curriculum Development	One year	50	0.48	3.11**
	Since project ended	47	0.17	0.90
Professional Development	One year	30	- 0.87	-2.70**
	Since project ended	24	- 0.71	-2.25*
Materials Development	One year	54	0.13	0.71
	Since project ended	49	- 0.59	-3.16**
Articulation Agreements	One year	17	0.35	1.00
	Since project ended	15	0.20	0.54
*$p \leq .05$ and ** $p \leq .01$.				

Changes are also shown between the end of funding an activity and the time of the survey in 2004-05. Course and curriculum development and articulation stayed about the same while professional development and materials development were perceived to have declined.

It needs to be pointed out that these results are from very soft data. They are based on the perceptions of grantees and could easily be viewed as self-serving. It is best to view them as suggestive and considered further in the light of the additional information that follows.

The persistence of collaborations. Another indicator of sustainability is the continuation of collaborative efforts established during the life of the grant. As a primary reason for funding this program, Congress cited "shortages of scientifically and technically trained workers in a wide variety of fields will best be addressed by collaboration among the Nation's associate-degree-granting colleges and private industry to produce skilled, advanced technicians" (Scientific and Advanced-Technology Act of 1992, § 2). Consistent with that intent, the evaluation question addressed in this section is, "Do the collaborations established by the projects persist after funding ends?"

Collaboration was defined in the questionnaire as " . . . an ongoing relationship with another institution, business, or group that provides money and/or other support to your project, center, or partnership." Many kinds of relationships were established by the projects. Table 6 shows the kinds and numbers of collaborating organizations during the projects' last year.

Table 6. Types and Number of Collaborating Organizations, Final Year of ATE Funding
(118 respondents)

Collaborating Organizations	Number	Percent
Business and industry	103	87
Education institutions	107	91
Public agencies	49	42
Other ATE projects and centers	46	39
Trade organizations	30	25
Private foundations	9	8
Civic groups (e.g., chambers of commerce)	12	10
Others	8	7
Total number	364	See note below

Note. Because multiple responses were made, the total is more than 100%.

As the table shows, the ATE projects in this study established 364 different collaborative relationships with a variety of organizations and institutions. Approximately 90 percent of the 118 respondents reportedly worked with businesses and industrial organizations and with other education institutions. About half formed partnerships with public agencies, for example,

chambers of commerce; and about a third worked with technician trade organizations and private foundations.

We asked the same question for 2004-05 and found the following.

By comparing Table 6 with Table 7, we see that the total number of collaborating organizations involved with ATE projects and centers dropped from 364 to 236, or about a 35 percent decline. According to the respondents, collaborations still exist but to a lesser extent. However, there is a reported fairly substantial degree of sustainability (65%) even several years after funding cessation.

Table 7. Types and Number of Collaborating Organizations, 2004-2005
(113 respondents)

Collaborating Organizations	Number	Percent of Respondents
Business and industry	63	56
Education institutions	70	62
Public agencies	30	27
Other ATE projects and centers	33	29
Trade organizations	17	15
Private foundations	9	8
Civic groups (e.g., chambers of commerce)	10	9
Others	4	4
Total number	236	See note below

Note. Because multiple responses were made, the total is more than 100 percent.

The distribution of the alliances was remarkably similar across the time span. For example, in the project's last year, 28 percent of the types of collaborations (103/364) were with business/-industry and 29 percent were with other education institutions. Thirteen percent were with public agencies and other ATE projects. In 2004-05, 27 percent (63/236) were with business and industry and 30 percent with education institutions. The figures were 13 percent and 14 percent respectively for public agencies and other projects.

The full comparison is shown in the chart below.

The grantees were still working with the organizations in the same proportion but to a lesser extent than they were in the last year of their grant.

Type	Last Year of Project (n=364)	2004-2005 (n=236)
Business/industry	28%	27%
Education institutions	29%	30%
Public agencies	13	13
Other ATE projects	13	14
Trade organizations	8	7
Private foundations	3	4
Civic groups	3	4
Other	2	2
Total	100%	101%

We also asked grantees to report the number of alliances that were formed with these kinds of groups. They provided data for the last year of their project and for the 2004-05 survey year. Scale categories on the survey were None, 1-5, 6-10, 11-15, 16-20, and 20+. These were coded from 0 to 5 and a mean score calculated. (See the chart below.)

Coded Value	Response Category
0	None
1	1 - 5
2	6 - 10
3	11 - 15
4	16 - 20
5	20+

The mean category score for the last year of the projects was 2.44. In 2004-05 it was 1.51. This is a statistically significant drop ($p \leq .001$).

Another way to view the change is to translate the mean ratings into numbers of collaborations. The average coded value in the last year of the projects was 2.44. This falls about midway between the 6-10 category and the 11-15 category. The midpoints of these categories are 8 and 13. Halfway between is approximately 10.5 collaborations per project. Because there were 116 respondents, the total number of collaborations of these projects is roughly 1,200 (10.5 x 116 = 1,218).

In 2004-05, the mean category rating was 1.51. Extrapolating this to the scale yields 5.5 collaborations per respondent. The total number of alliances in this year was about 600, about half of that during the project's last year.

Admittedly, this approach makes several assumptions, but it does seem to provide an indication of the extent of sustainability of the ATE projects. While the number of collaborations was cut in half, there still appears to be considerable collaborative work taking place, especially considering that 20 percent of the grants had ended six or more years earlier. Of course, this does not consider the fact that the community colleges probably had collaborations before receiving the grant. Our findings from another study within the larger evaluation (Germuth, Gullickson, Lawrenz, & Hanssen, 2006) seemed to show that the collaborations were likely to increase in intensity with the grant but that many were in place prior to the grant.

The above results are for all of the ATE tasks combined. The same analysis was done for the separate tasks, course, curriculum, materials development, professional development, and

articulation agreements. Similar patterns were found although the number of cases for some tasks was small.

Postproject funding support. Another indicator of sustainability is the ability of projects to receive funding after ATE support ends. Respondents were asked to report the number of dollars (non-NSF) they received, both direct and in-kind, in the last year of their project, a year later, and in 2004-05. We were uncertain how the funding patterns would change, but assumed there would be some decrease after the project ended. However, if the projects continued to receive some support, this would indicate some degree of sustainability.

Table 8 reports the level of support at three points in time.

Table 8. Direct and In-Kind Support of ATE Projects at Three Different Times

		Last Year of NSF Support	One Year After the Project Ended	In 2004-2005
N	Valid	105	102	91
	Missing	31	34	45
	Mean	$117,000	$44,000	$28,000
	Minimum	$0	$0	$0
	Maximum	$2,106,000	$1,350,000	$530,000
	Sum	$12,336,000	$4,447,000	$2,586,000

Note. All dollar values are rounded to the nearest thousand

A sharp drop-off in funding occurred in the year following ATE support, and this continued to 2004-05, although at a lesser rate. Because not all respondents provided data for all three points, dollar averages provide the best perspective of changes in support. The average non-NSF funding per grantee dropped by more than half in the first year following grant completion. In 2004-05, the amount was a third smaller than it was one year after the project ended.

The average support dropped from $117,000in the last year to $28,000 in 2004-05. Given that NSF funding also ended, this is a steep decline. The average NSF award to the projects in their last year was about $200,000. This means the total support dropped from more than $317,000 to $28,000. This is not strong evidence of ongoing project activity.

Another data point is the number of projects reporting no supplementary support during these three time intervals. These numbers are listed below.

Projects Reporting No Supplementary Support

Time Period	Number With No Support	Percent of Reporting Projects
Last year	30	22%
Year after	54	40%
2004-05	53	39%

Here, again, the pattern of a sharp first-year drop-off followed by a leveling off is revealed. There is some evidence of sustainability but not at the levels obtained during ATE funding.

We thought that perhaps that those projects and centers that received the larger grants and were funded for longer periods of times might have higher levels of sustainability. Accordingly, we calculated the correlations between levels of sustained funding and the amount and length of the NSF funding. None of the correlations were larger than 0.16, and none of them were statistically significant.

We also computed the correlation between funding the year after the project and for 2004-05. There were slight negative correlations, but they were very small: -0.04 and -0.16, and not statistically significant.

Adoption of project work by other institutions. A project that has its ATE work adopted by other organizations or institutions is more likely to endure than one that does not. We considered this an indicator of potential sustainability even though we have no data on the extent of use by the adopting institutions. We asked our respondents to report this information for the various products they developed. Table 9 shows the number of adopting institutions for four work products: courses, curricula, professional development, and materials development.

Recall that the respondents were asked to choose two tasks that were a focus of the project and to answer only questions about those two tasks. Because many projects had multiple tasks, some of the work conducted will not be included in this part of the survey. This means that among the "no response" numbers were only those who answered questions about the two tasks they selected from a list of six possibilities (see Table 1). This would tend to underestimate the number of adopting institutions. The results for four tasks are shown in Table 9.

Table 9. Number and Percentage of Projects Reporting Product Adoption by Other Institutions

(Number of projects in sample = 136)

	Product Category			
	Courses	Curricula	Professional Development	Materials Development
Number Reporting Adoptions	43	22	18	42
Percent of Sample Reporting Adoptions	32%	16%	13%	31%
Answered "Zero" or "Don't Know"	32	33	17	20
Question Not Answered	61	81	101	87

We were interested in determining the total number of institutions that adopted ATE products. The question about this topic was, "To the best of your knowledge, approximately how many INSTITUTIONS have adopted at least one of the courses you developed with ATE funding? Select one."

These were the response categories:

0	None
1	1-10
2	11-20
3	21-50
4	50+
99	Don't Know

However, these categories do not lend themselves well to this kind of analysis. A rough approximation can be made by computing the mean category rating using the category midpoint.

Consider, for example, the number of institutions adopting courses. The mean category rating was 1.5. This is midway between the categories 1-10 and 11-21. The extrapolated value would be 11.0. Because 43 projects had an average of 11 adopting institutions, one might estimate there were approximately 473 (11 x 43) institutions that adopted at least 1 ATE developed course. Comparable estimates for all 4 products are listed below:

Product	Total Number of Institutions
Courses	473
Curricula	132
Professional Development	85
Materials Development	756

These figures are estimates to show that some ATE products could be sustained through use at other institutions. We do not know the extent of adoption or how much they were continued after the originating ATE grant ended. We only know that a greater potential exists than if there were no institutions that adopted the products.

Concluding Remarks

We examined the extent of ongoing work among 136 projects that ended prior to September 1, 2004. We were seeking evidence of sustainability, sometimes called residual impact. Five questions were addressed in this evaluation. The questions and our findings are presented below.

1. Is project productivity continued after funding ceases?

   The perception of our respondents is that productivity remained the same or increased slightly the year after funding ended except for the professional development task. These perceptions also were held for the longer run between project end and 2004-05 except for materials development. However, the reader is reminded to view these findings cautiously because of the nature of the survey items. Further investigation is needed to check on the validity of the questions. We note that of the five categories, professional development and materials development are viewed to rely most heavily on external funding support. For example, professional development almost always carries

with it travel costs and/or expectations for reduced load or substitutes to cover instructional needs.

2. Do the collaborations established by the projects persist after funding ends?

   A large number of collaborative relationships were established during ATE funding. For example, The Evaluation Center reported a total of 5,134 collaborations in 2005. This was obtained from their annual survey of active projects (n=163). Active projects are those that had been receiving funding for at least 1 year at the time of the survey.

   In our sample, with 118 people answering the question, the number was about 1,200 during the last year of their project. The average final year was 2001. The most common alliances were with business and industry and other education institutions. In 2004-05, the reported number had fallen to about 600, about half the number in place during the last year of funding. However, this seems a fairly substantial number, especially remembering that 50 of the projects had ended nearly 6 years earlier.

3. Does the level of support, both direct and in-kind, change after the project ends?

   The average amount of support beyond the ATE grant was about $117,500 during the last year of the projects in our sample (n=105 for this question). A year later it had dropped to $43,600, a decrease of 63 percent. In 2004-05, the average supplemental funding was $28,400, or about 24 percent of dollars received during the project's last year. This is a substantial decline, especially when considering that may be the total support projects receive.

   The average project received about $200,000 from NSF during its last year. This means that projects had about $317,000 in total financial support during their final year. In 2004-05, the total support fell to $28,400.

   The sustainability of projects to develop new materials or programs is severely diminished. We did not ask our respondents what the funds were used for, but it is doubtful any new endeavors could be started with such limited funds.

   While the number of collaborations decreased by 50 percent, funding levels dropped more precipitously. It may be that the alliances are still in place, for example, between a two-year college and a local industry. However, these alliances did not yield very much financial support a few years after NSF support ended.

4. What is the extent of adoption of project work products by other institutions?

   When all the adoptions were considered together, 54 sites reported that at least 1 of their products was adopted by another institution. The average number of adopting institutions per project was 12, yielding a total of 648 adopting organizations for our sample. Thus, the potential for sustainability is there if these institutions continued using the products. Since we don't know the extent of their use, all that can be said is that the potential for sustainability exists.

5. What was learned in this evaluation that has implications for improving sustainability of NSF-supported projects?

Taken as a whole, there is evidence of sustainability, especially when continued efforts are not dependent upon a continued influx of funding. The data do not suggest that productivity increases upon cessation of ATE funding. Rather, projects at best tend to continue at least some of their work efforts initiated with ATE funds. Declines are greatest where work continuity depends heavily on external support. The evidence obtained, however, is not strong, especially because it is based on principal investigators' recollections of practices, productivity, and support across several years.

Although the concept of residual impact has been on the minds of NSF staff for several years, planning for sustainability did not appear in most program solicitations until 2002. Even the 2001 ATE solicitation did not specifically address the topic. It first appeared in the 2002 RFP, and even then it was only part of one sentence, stating that the project description should describe "the prospects for sustainability after the period of NSF funding" (NSF Program Solicitation NSF 01-52).

This was the same year that the Math/Science Partnership (MSP) program began as part of the No Child Left Behind initiative. The MSP solicitation devotes a full section to Institutional Change and Program Sustainability and gives proposers a set of questions to address in their proposals. It asks proposers the following:

- What is the potential of the proposed partnership to foster and sustain the reform efforts in the long term?

- Is there an effective plan for bringing the endeavor to full scale and for sustaining the effort while maintaining high quality once NSF support has ceased?

- Even at the earliest stages, do the partners provide evidence that their involvement in the project will likely lead to changes in their institutions? (Program Solicitation, NSF-02-61)

There was a rapidly changing attitude toward sustainability at the Foundation in general, and ATE in particular, during the years included in our study. However, more than half of the projects were funded before sustainability was even mentioned in the RFPs. This might be the reason behind the rather limited sustainability found in this study. It was just not part of the mind-set at that time. (Similar changes were occurring with required evaluations, use of advisory committees, and dissemination.)

The first suggestions on how to increase residual impact appeared in a paper published by The Evaluation Center (Lawrenz & Kaiser, 2002.) This was followed by a brochure, *Guide for Improving Sustainability* (Lawrenz & Kaiser, 2002). Also, the topic of improving sustainability has been included in ATE's annual PI meetings since 2003 and at a meeting of center directors in 2003.

ATE center directors and proposal writers were given more information on how to enhance sustainability in a video conference held in February 2003. (Bailey, 2003). However, these support efforts would not have much impact on the PIs included in our

study. It appears that sustainability was more a by-product during the program's earlier years, similar in some ways to evaluation, than it was a carefully planned activity expected as part of any project. It would be interesting to repeat the current study, say in 2010, to see if the increased efforts on the part of ATE and NSF to enhance sustainability are successful.

We did make a comparison of the funding received by projects in 2004-05 with those that ended in 2002 or before and those that ended after 2002. We were interested to see if the greater attention being given to sustainability would have an impact on the extent of residual impact between the older and more recently ended grants. There is a difference. The average direct and in-kind support for the more recent projects is greater than those that ended before 2002. The mean values were $35,400 for those that expired in 2003 or 2004. The amount was $24,900 for the older projects that expired between 1995 and 2002. These differences seem substantial but were not statistically significant because of the large standard deviations in the amounts. The amounts ranged from zero to $700,000, and some standard deviations exceeded $50,000. This generates large standard errors, and statistical significance is difficult to show.

In addition, this kind of analysis may be affected by the recency factor. Despite the increased attention to sustainability at NSF, it seems likely that newer projects would naturally tend to be more active regardless of their attention to continuation. Evaluation designs need to be set up to account for this and other confounding effects.

This evaluation has found some evidence of residual impact among expired ATE projects and centers. The extent is not large but is encouraging. Even among projects eight and nine years beyond NSF funding there are signs of life. As more and more attention is given to building mechanisms for sustainability early in a project, one would expect to find increased evidence of active and vital efforts to improve technological competency after NSF funding stops.

Having concluded that the residual impact of these ATE grants is not large, especially for professional development and materials development, we add that it may be that we have overlooked two important ways in which the efforts of the ATE program will continue. These are the products of the grants—namely, extant materials and procedures and a cadre of people who have been involved in the process, including new technicians. These will continue and are likely to have impact on future technician development efforts.

Two things come to mind here to support these ideas. First, there was tremendous curriculum development supported by the National Science Foundation in the 1960s and '70s. Studies of those curricular materials, as we recall, showed that adopting schools tended to use the new materials for a short span of time (e.g., three years) before reverting to their former texts. The conclusions then were that the NSF materials were not having the desired impact in the schools. Certainly, the impact was less than desired. Yet, anyone who picks up current textbooks in these curricular areas sees the seeds of the NSF "alphabet curricula" in them. The references are often directed to the NSF-developed materials. Just as often, the approaches taken to explore new ideas parallel those applied for the first time in those materials development efforts. If we are patient and willing to trace materials development work for the

longer term, there may be a similar pattern of reference to these ATE-developed materials as teachers use them and new developers adapt and apply these ideas in their own work.

Second, we did not examine sustainability in terms of improved knowledge and understanding on the part of project directors and their staffs or on the part of new technicians. Indeed, regardless of the sustainment of direct project activities, collaborative relationships, and dissemination of materials, these ATE grants must be viewed as potent professional development activities.

Future studies of sustainability should address these points directly because the many facets of the ATE program that we have studied in our evaluative efforts indicate that the principal investigators and their staff members do increase their knowledge, capabilities, and productivity through their grant efforts. It seems likely that we could have provided stronger, more positive conclusions about sustainability with such information in hand.

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