ASSESSING THE IMPACT AND EFFECTIVENESS OF PROFESSIONAL DEVELOPMENT IN THE ADVANCED TECHNOLOGICAL EDUCATION (ATE) PROGRAM

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> We cannot expect [instructors] to teach what they do not know, nor to use yesterday's training to prepare today's students for tomorrow's future."
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> (Sparks & Hirsh, 1999)

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Abstract

The purpose of this paper is to describe and assess Advanced Technological Education (ATE) professional development experiences and to aid community colleges throughout the nation in their efforts to meet the new challenges posed by rapidly developing high-technology sectors. As they adapt teaching and curriculum to the needs of a new generation of technology professionals, colleges will have to invest in effective ongoing professional development for their faculties. This paper presents the thinking of researchers and training experts, as described in research mostly on training on the use of educational technology in the classroom, and the experiences of ATE *projects*[4] across the country. Knowledge and insights gained from the ATE evaluation will be described and placed in the context of the current state-of-the-art thinking on best practices.

For the institutions housing ATE *projects*, several issues emerge from a review of current literature on training on the use of educational technology in the classroom.

- Community colleges all need to tool up quickly to meet the demands of the high- tech sector.
- Current planning and program development procedures are not designed to be responsive to rapidly changing technological fields. Most colleges have a five-year program/course development cycle.
- Staff development programs have not been designed for rapid faculty skills development, and it is generally a lower priority for funding than other areas.
- Faculties who are trained and certified are in short supply, and the recruitment pool is limited due to the high industry demand for skilled employees.

These issues have provided challenges to the institutions housing ATE *projects.* It is likely that the experiences of the *projects* in overcoming the many barriers for colleges to providing quality faculty training on the use of educational technology in the classroom may be invaluable to other settings, and the lessons learned will be the focal point of this paper.

In order to assess the 13 ATE sites visited by the Western Michigan University (WMU) evaluation project, an evaluation regime has been created through review of current professional development literature on the use of educational technology in the classroom that identifies 7 basic elements constituting effective training programs. They are: (1) ongoing learning and training, (2) institutional support, (3) hands-on and classroom-based experiences, (4) individualized training, (5) follow-up training, (6) mentoring, and (7) a train-the-trainers approach to continuing education. Evaluation findings, primarily based on site visits, reveal that the more of the 7 elements an ATE site employs, the more likely it is that desired outcomes would be achieved. The data indicate that the ATE sites are succeeding in developing training that provides improved teaching, enhanced technology skills, and greater

[4] *Projects* indicate ATE centers and projects, two funding categories used by NSF.

opportunities for long-term professional development for community college instructors and secondary teachers in the use of educational technology in the classroom. An important finding of the review of site visit findings is that the professional development ATE *project* staff members have received would not have been available without NSF-ATE funds. They have stressed that the training they received because of NSF-ATE funding has been instrumental to their improvement efforts.

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

Examining Issues in Professional Development: An Overview

As secondary and postsecondary students think about careers that may interest them and as educators plan the curricula to prepare their students for the workplace, the continuing evolution of technology affects both. The tech sector includes a wide array of science- and math-based occupations with all five computer-based occupations projected to be the fastest growing fields in the first decade of the 21st century: computer engineer, computer support specialist, computer systems analyst, database administrator, and desktop publishing specialist (Occupational Outlook Quarterly, 2000, Summer). Much of the burden for producing the new generation of technology professionals has fallen on community colleges and their faculties, which are being asked to provide analogous training to students, industry employees, and university instructors. To help meet the rapidly expanding demands for technology training, the Advanced Technological Education (ATE) program[5] has targeted significant funding for professional development of community college faculties.

Current ATE programs are an essential element of this paper, which is intended to provide information and guidance for community colleges developing and/or expanding their technology education programs. The paper will take a three-pronged approach:

(1) Examine what is happening in professional development programs and what more is needed
(2) Review professional development literature for the state-of-the-art[6] on training on the use of educational technology in the classroom
(3) Evaluate the impact and effectiveness of the ATE professional development programs

Experts in the fields of technology education and professional development who have reviewed the current situation broadly agree on the needs and a set of responses. To meet the demands of students for a first-class education and of employers for highly skilled workers, community college faculties must keep pace with rapidly changing technologies. High quality, ongoing professional development for faculty is imperative. Yet, according to Tenbusch (1998), "National statistics have shown that [instructors] receive far less on-the-job training in technology than any

[5] Please see the attached overview document (*The ATE Program: Issues for Consideration)* accompanying this paper for a detailed description of this program and its evaluation.
[6] Much of the current literature on professional development, technology training, and technology integration addresses K-12 levels. While the elements of effective professional development span time and topic, it is apposite for the reader to consider that the community college perspective and faculty needs may differ.

other group of professionals" (*Electronic School*, 1-6). The U.S. Congress, Office of Technology Assessment (as cited in Brand, 1997), reports it is the lack of staff development that is the primary stumbling block in providing excellent technology instruction.

If our primary educational goal is to prepare students for a technological world and, if we believe that instructors are the first learners, then providing faculty with state-of-the-art professional development becomes a top educational priority (Hord, 1997). It is no longer acceptable to present an occasional staff development workshop. Indeed, professional development should be part of the daily life of instructors with time provided to work in collaborative groups, conduct research, give and receive mentoring, and enhance knowledge and skills. The model of staff development for technology must put the instructor/learner at the center of the learning experience and provide a meaningful context for learning (Stager, 1995).

It is the instructor/learner and their institutions that are the primary concern of this paper. In the following section, we review current literature about the state-of-the-art on training on the use of educational technology in the classroom, looking at three issues:

(1) What is happening and what is needed in professional development at the community college level
(2) What we can learn about professional development from industry and service provider trainers
(3) What makes up exemplary professional development programs

Surveying the Scene: Factors that Limit Professional Development

Perhaps the biggest problem in the area of professional development for educators, particularly at the postsecondary level, is the very lack of it. The scarcity of staff development tends to result from three factors that emerge over and over in the professional development literature. These factors are:

1. *Time, or more accurately stated, the lack of time is one of the most difficult problems faced by schools* (Watts & Castle, 1993). In fact, Fulton & Miles (as cited in NCREL, 1997) say that time is the key issue in every analysis of change in education in recent years. Cook (1997) adds: "A fundamental lesson learned in the past decade of school reform efforts is that far more time is required for professional development and cooperative work [among faculty members] than is now available." Corcoran (1995, cited in NCREL, 1997) stresses that faculties "need more time to work with colleagues . . . and to revise curriculum."

2. *Both the public and policymakers fail to give professional development a high priority.* It is a commonly held belief that faculty members should know what they need to know before they begin to teach and should, therefore, spend their time in the classroom. "[T]he public and policymakers perceive [instructors'] work has not changed. They continue to think [instructors] are working only when they are with their students . . . Education must

respond to the changing needs of students and [faculty], just as business has reacted to its changing needs by implementing employee training" (Darling-Hammond, 1991).

3. *Professional development is lacking not only in quantity, but also quality*. Community colleges have tended to undervalue professional development, making faculty members responsible for their own continuing education. In reality, if staff development for instructors is to be truly effective, administrators must not simply pay lip service to the cause. They must take supporting action (Persky, 1990).

It is clear that the traditional professional development model for educators is inadequate to meet the existing need for technology training among community college faculty. Traditional professional development, according to McKenzie (1991), typically has several all-too-well-known components:

- One-size-fits-all training
- Occasional half-day or day-long workshops
- Limited time to practice new skills/employ new knowledge
- Little or no follow-up to workshops
- Lectures from outside experts about the latest educational trends
- Little or no compensation for time spent
- Ineffective planning and inadequate budgets to provide training that will transfer to the classroom

Jamieson McKenzie, editor of *The Educational Technology Journal*, states that making the change from traditional staff training is the fundamental issue in providing effective professional development: "Shifting from industrial age thinking and teaching to information age thinking and teaching is as dramatic an adjustment as shifting from teaching in a classroom to teaching underwater. The training agenda is no simple list of skills; everybody must learn an entirely new approach" (April 1991).

In regard to poor planning, McKenzie says: ". . . training often occurs at the wrong time of the day in a room that is either too hot or too cold, and the instructors are often expected to subsidize the learning process with their own time and money . . . Quite a contrast with training in private industry that takes place in comfortable training centers or hotels with good food and superb session leaders!"

Professional development literature has consistently stressed the "continuing" part of continuing education. Since the 1980s, staff training researchers and practitioners have talked about ongoing training. They have urged follow-up sessions in the weeks and months after workshops to sustain new practices. They have preached the importance of encouraging and supporting instructors (through in-classroom coaching by trainers and peer leaders) to continue learning and implementing new knowledge and skills, lest the momentum for change be lost (Bents & Howey, 1981; Joyce & Showers, 1983; Sprinthall & Sprinthall, 1980).

When follow-up has occurred, half the participants in ATE programs report trying training materials in their classrooms and one third report implementing them (Gullickson, Lawrenz, & Keiser, 2000). These responses suggest that more follow-up is required to support instructors in trial and implementation of new materials and teaching techniques. Indeed, the need for concentrated attention to professional development training and follow-up is picturesquely described by McKenzie: "Greater time and resources must be devoted to teacher learning, and greater attention must be given to the needs of teachers as adult learners. A generation of teachers who view themselves as pioneers, inventors, and discoverers must be nurtured so that when the waves of the future hit the shores of our present our teachers will dive headlong through them rather than ducking, running for shore, or allowing themselves to be swept away."

Over the past decade, much has been learned about what makes up effective professional development and that overcomes the deficiencies listed above. The next section identifies what has been learned about the aspects associated with more effective professional development.

Identifying Qualities that Define Effective Professional Development and Designing an Assessment Structure

The need for concentrated attention on crafting and instituting effective professional development programs is perhaps best stated by Sparks and Hirsh (1999): "We cannot expect [instructors] to teach what they do not know, nor to use yesterday's training to prepare today's students for tomorrow's future. We certainly cannot expect our [instructors] to share and learn from each other's knowledge and skill unless we provide them with the research, structures, time, and money with which to do it. Ultimately, quality staff development benefits students by channeling the talents and expertise of all the school's faculty in all the school's classrooms. By improving staff development . . . , "we will be helping all [instructors] to excel at helping all students reach the high levels of achievement they need to succeed."

Current professional development literature delineates the basic qualities that comprise effective and successful staff training. Consistently, seven elements emerge as necessary for high-quality professional development programs:

(1) Ongoing learning and training
(2) Institutional support
(3) Hands-on and classroom-based experiences
(4) Individualized training
(5) Follow-up training
(6) Mentoring
(7) Train-the-trainers approaches to continuing education

Here is what the literature tells us about why these elements are important:

Element 1: ongoing learning and training. Stager (1995) and Dobbs (2000) stress that professional development should be a part of instructors' daily lives. Instructors must have the time to gain new knowledge and skills for courses in a wide range of technology fields with training and development on a continuing basis to keep up with changes. Staff development for technology requires adaptable training content and sufficient opportunity for working with the tools over time (Sparks & Hirsh, 1999; Guskey, 1999).

Corporate America has long recognized the value of ongoing learning, and companies are promoting it among their employees (Dobbs, 2000, January). Dean Spitzer, senior performance consultant with IBM, suggests staff development strategies for education:

> "[T]o affect [instructors'] content knowledge, instruction skills, and student learning . . . the staff development effort [must be] sufficiently powerful to accomplish those purposes. [E]fforts must be sustained over months and years, provide a great deal of in-classroom demonstration and coaching, and offer generous amounts of time for small groups of faculty members" to work together developing curricula, instituting and evaluating new instructional methods, and solving common problems. "Nothing less will get the job done" (Cited in Sparks, 2000, March).

Guskey (1986) and more recently Kimmel, *et al* (1999) note that it has become accepted that long-term intensive professional development programs are necessary and that short in-service programs or workshops are not sufficient to produce sustained change (Guskey, 1986). Conferences, workshops, and in-service training, however, continue as the most popular forms of professional development in the ATE program. Assessment of the current ATE sites indicates that 15 percent or less provide other learning activities, internships, or online courses (Gullickson, Lawrenz, & Keiser, 2000).

Element 2: institutional support. Persky (1990) notes that administrative support must be strong to ensure effective professional development. Despite resource constraints, time and money is required for good staff training. Tenbusch (1998) acknowledges the concerns of educators and administrators regarding resources for professional development but, he says, it's possible. In an article written for *Electronic School* magazine, Tenbusch notes: "The business community knows that for every dollar spent on hardware and software, another dollar must go toward staff development. Developing a successful [instructor] technology-training program requires more than turning [the] faculty loose after a few workshops. . . . [A]dequate training for [instructors] can be expensive, in terms of both time and money. But if [schools and community colleges] don't do a better job of allocating resources for professional development—instead of putting all the budget into technology acquisition—[they] will be left with the tools but not the talent to prepare [students] for a technological world."

Faculty support is also a piece of the training pie, but it is often missing. Tenbusch (1998) offers some field-tested strategies for building faculty support for and interest in technology training: A successful professional development program in technology must focus on enhancing knowledge and giving faculty members the incentives to expend the time and energy to learn what they want and need to know. There are four basic parts to an effective training program: (1) intensive training with opportunities to work with new ideas and materials over several sessions, (2) follow-up with trainers and/or mentors over an extended time period, (3) time to consult with colleagues, and (4) occasional observation of other instructors who use exemplary techniques.

Effective staff training, then, requires that administrators and instructors establish the structure that will allow professional development to occur. That structure includes:

- Setting schedules that allow for flexibility
- Providing opportunities for instructors to complete the development sessions on their own time, at their own pace
- Offering a combination of learning circumstances, such as traditional workshops and in-class collaboration
- Creating sessions around small groups for more individualized attention
- Using instructional variety to present information and teaching skills (Browne & Ritchie, 1991; Harvey & Purnell, 1996; Stager, 1995)

Element 3: hands-on and classroom-based experiences. State-of-the-art staff training is hands-on, classroom-based, and student-centered. It presents analytical problems, using inquiry techniques; it promotes modeling; and it relies on instructors and development professionals working together to create plans, present information and skills, evaluate and redefine education programs, and present refined curricula to meet student and marketplace needs. And, it requires substantial time for instructors to acquire and, in turn, transfer new knowledge and skills to their students (Brand, 1997; Guhlin, 1996; Shelton & Jones, 1996).

Element 4: individualized training. Because instructors vary in their levels of expertise at the time of their training, the context, which surrounds their technological professional development, must provide a nonthreatening environment that is sensitive to the individual instructor's level of expertise and experiences (Browne & Ritchie, 1991; Shelton & Jones, 1996). Instructors must have significant blocks of time in order to acquire and apply the knowledge and skills necessary to effectively use and teach technology. They also need time for collaborative learning and time to develop the networks that promote collegial learning. To help faculty members complete the "learning *cycle" of computer-related professional development, training must be ongoing and systematic (Brand, 1997).*

The economics and logistics of staff development will continue to push us to train instructors in groups, but we must remember that the technology itself allows us to individualize instructor learning and provide support in ways that offer new economies of scale. For example, colleges can provide Internet courses that faculty members can take on their own, videos for at-home

instruction, one-on-one online mentoring, and other forms of personalized, just-in-time, just-what's-needed formal and informal instruction (Fulton interview by Sparks, 1998).

Element 5: follow-up training. A part of ongoing training is the follow-up to professional development opportunities and activities. Being able to work with mentors and colleagues to reinforce new knowledge, skills, and techniques augments both what has been learned and the confidence to use it. There is considerable agreement that collaborative group work and learning is the most powerful kind of reinforcement in professional development (Arter, 2001; Garmston, 1999; Johnson & Johnson, 1999). In several studies, instructors cite the opportunity to collaborate as the most important factor in instituting change. Research evidence also indicates that learning in groups significantly improves learning for adults as well as for children (Arter, 2001).

As a result, Stager (1995), Browne & Ritchie (1991), and Persky (1990) suggest that collaborative problem-solving and cooperative learning must undergird the approach to technology learning for instructors. Although a number of approaches are available, peer coaching and modeling have been most effective in transforming workshop information to classroom applications and practice (Browne & Ritchie, 1991; Persky, 1990).

Element 6: mentoring. Perhaps the greatest challenge for instructors is putting newly gained knowledge and skills into action. Doing so is greatly enhanced by having someone to guide and advise, someone with whom instructors can discuss and plan—a mentor. Unfortunately, providing mentors is not a part of most professional development programs. The literature suggests that the lack of emphasis on mentoring results from misconceptions about professional development for educators. Public assumption (and sometimes the assumption of administrators) that instructors are only working when they are with their students is a barrier to establishing staff training programs and to providing the support systems necessary for training success. International studies that have compared the daily activities of instructors in other countries have shown that staff development has considerably greater importance abroad. For example, in Japan instructors teach fewer classes than their American colleagues and they use the added time to plan, meet with peers, work with students one-on-one, and participate in professional development (Darling-Hammond, 1994, November).

Susan Loucks-Horsley of the National Research Council agreed, pointing out that pre-service training, professional development, and ongoing support for instructor learning and development are often more robust in other countries. "In many places, [instructors] have fewer student contact hours and more time to work together. While it would be a mistake to try to pattern ourselves after other countries because of the vast cultural and population differences, exploring what we can learn from the rich data base can help us look at ourselves and view images of what can be different" (Sparks, 1997).

The need for concentrated attention on crafting and instituting effective professional development programs and for sharing best practices is, perhaps, best stated by Sparks and Hirsh (2000):

"We cannot expect [instructors] to teach what they do not know, nor to use yesterday's training to prepare today's students for tomorrow's future. We certainly cannot expect our [instructors] to share and learn from each other's knowledge and skills unless we provide them with the research, structures, time, and money with which to do it."

Element 7: train-the-trainers. A train-the-trainers approach to continuing education can provide more instructors with more opportunities to learn and be a means for conserving limited professional development resources. In addition, business offers an additional incentive: the observation that colleagues provide each other with a great deal of "informal learning" that may not occur in staff training programs. The Education Development Center, Inc. (EDC) conducted a 2-year study of U.S. corporate cultures, including workers' training. One of the findings of the study was that 70 percent of what employees know about their jobs, they have learned informally from the people with whom they work. The lesson: Education institutions must provide opportunities for instructors to spend time with colleagues so that they can learn from them and their experiences (Dobbs, 2000). Indeed, colleges should encourage and support the development of interactive faculty and provide opportunities for training to occur formally and informally. In the words of a recent report funded by the Benton Foundation ("The Learning Connection: Schools in the Information Age"): "[W]e must build a human infrastructure at the same pace we are building computers and wiring" (Sparks, 2000, an interview with K. Fulton).

Integrating the Elements: Examples of Best Practices

While many programs exist to help elementary/secondary teachers infuse technology into their curricula, professional development for postsecondary technology instructors is largely absent or incomplete. A review of the American Association of Community Colleges' library and online resources indicates that comprehensive professional development programs at community colleges are indeed few and far between.

On the other hand, two programs that receive frequent praise are early ATE participants. The first is Northwest Indian College in Bellingham, Washington. The college developed a team teaching approach with Western Washington University and conducted faculty-training programs stressing the fundamentals of coordinated studies and learning communities. The positive effects on student learning convinced instructors and administrators that, while the cohort approach to teaching and learning is very time-intensive, the program should be retained. Faculty, administrators, and students reported more integrated curriculum, student-centered teaching techniques, and hands-on learning—all credited for increased student commitment, higher retention of students and staff, and more students completing their studies (Mahoney & Barnett, Ed., 2000).

The second project is a three-phase program to develop improved technology programs and teaching methods at Queensborough Community College (QCC) in New York City. Using telecommunications technologies as a means for instructional change, QCC has focused significant effort on faculty enhancement. The goals are to provide science and technology

students with more marketable skills, develop methods to keep curricula on the cutting edge, and to improve faculty skills.

QCC's project has been based on the belief that traditional approaches to improvements in instruction have simply attempted to put new technology on top of existing teaching techniques. Doing so has not proven very effective in providing students with the knowledge and skills they need, and the college recognized a pending critical shortage of successful science and engineering technology students unless instructional methods became more effective. The resulting professional development at QCC has served not only the college's own faculty, but has drawn participants from across the United States, Puerto Rico, Japan, and the Netherlands to audit and observe staff training. The college has experienced extraordinary success with technology integration and student retention/completion (Mahoney & Barnett, Ed., 2000).

There are many other technology experts, researchers, and trainers who, from their experience and expertise, can provide diagrams for model professional development. One such group, the Southern Technology Council, reviews the best of professional development programs and notes best practices. Reiterating advice from business, the Council notes, "Mandates and incentives are dominant themes in establishing successful professional development practices." Brand (1997) points out that the need to allot time for continual learning is echoed in studies outside education, which suggest that providing workers with high technology ultimately fails if employees do not receive adequate training and continual, on-the-job support. Other best practices include:

- Requiring instructors to earn in-service credits in continuing technology training
- Providing monetary incentives for professional development in technology
- Offering stipends to faculty who conduct workshops on a piece of software or an application with which they are expert
- Rewarding faculty members who receive training with free hardware or software
- Offering interest-free financing to instructors who want to purchase/upgrade personal computers
- Allowing instructors to take school laptop computers off campus
- Requiring faculty members who are interested in receiving free Internet accounts to attend training (Southern Technology Council, cited in Tenbusch, 1998)

Several corporations and business associations recognize and practice such supporting techniques with their employees as part of an effort to motivate workers to take part in professional development. Studies in the business sector indicate that providing workers with highly developed technology training fails if the employees do not receive adequate incentives (Brand, 1997). Putting their money where their mouths are, several corporations and business associations throughout the U.S. are working with secondary and postsecondary institutions to share what they have learned. They hope to
increase professional development in technology and to promote the transition of students from education to work. Organizations with active partnerships include:

- American Airlines
- Consortium of Allied-Signal, Goodyear, Honeywell, Hughes, McDonnell-Douglas, and Motorola
- Institute for Women in Trades, Technology, and Science
- National Association of Automotive Dealers
- National Association of Manufacturers
- National Center on Education and the Economy (http://proquest.uni.com/pqdweb)

Some bottom-line advice comes from IBM consultant Dean Spitzer. He suggests that professional development needs to be based on the driving concerns of the business—revenue, profits, customer satisfaction, market share, cycle time, production quality, and employee retention rates (Spitzer, 1999, June). For education, that means looking at staff development in terms of its intended outcomes:

- Faculty satisfaction with what they have learned
- Student satisfaction with what they learn
- Student retention
- Student referrals that bring in other students
- Professional development time spent as compared with the results
- Faculty retention rates
- The community college's market share of students

While the role of community colleges is to provide educational opportunities and prepare students for the future, the schools have to be monetarily successful in order to maintain their programs.

The American Association of Community Colleges (AACC) points out that constraints on public funds show no signs of abating, as more legislatures predicate budget increases upon performance of specific goals. Competition is pushing community colleges to consider students as customers. In turn, emphasis on students' learning is growing as employers and society expect students to demonstrate competence in what they have been taught. Assuring the knowledge and expertise of community college faculties must be a critical part of every successful school's plan for the future (AACC Research, 2000).

Assessing Professional Development Across the ATE Sites

Ideally, every professional development program will be based on research and needs assessments and will incorporate the basic elements that make up effective training programs. Those elements, described in the "Identifying Qualities That Define Effective Professional Development" section, are:

(1) Ongoing learning and training
(2) Institutional support
(3) Hands-on and classroom-based experiences
(4) Individualized training
(5) Follow-up training
(6) Mentoring
(7) Train-the-trainers approaches to continuing education

Assessment of the 13 sites visited by the WMU evaluation project reveals a varying adoption of the 7 elements of effective professional development. Often times, the institutions have introduced 1 or 2 elements of a training program, planning to add others as they progress. Practically speaking, organizations may have to decide which professional development elements are more important to them and which their resources will permit them to introduce. *It is essential, however, to keep in mind that the fewer elements present in the training program, the less likely it will be that desired results will occur and/or that the program can be sustained.*[7]

Element 1: ongoing learning and training. Professional development should be ongoing, a part of instructors' daily lives with time to enhance their technology knowledge and skills, to learn new methodologies, and to work in collaborative groups (Stager, 1995; Dobbs, 2000). Twelve of the 13 ATE sites report ongoing professional development.

ATE Site 1 has identified the need for instructors to receive initial and ongoing training as essential to effective program implementation and dissemination.

ATE Site 2 recognizes the need for continued professional development. The only questions are what form that development should take and how it will be funded. To date, college funds have not been sufficient to provide appropriate faculty training. ATE funding has made access to professional development possible and future funding is assured from the site's county.

ATE Site 3 has focused on ongoing professional development opportunities. Instructors have continuing workshops and training experiences throughout the year, presented by knowledgeable trainers in content areas that have been identified by the participants as needed. Site 3's approach assures current classrooms by keeping faculty members up-to-date.

ATE Site 4 has begun a professional development training and support program for faculty members who want to change their instructional methodologies. The program plans continuing assistance as an integral part of the staff training. A central element of the ongoing training is the planning for new criteria to be applied as instructors are added and/or replaced.

[7] The assessments in this section are based on self-reporting from the ATE site visits. Each site has noted the elements of effective professional development that it has incorporated into its training program.

ATE Site 5 has established a 3-year teacher-training program that includes workshops modeling curriculum and laboratory environmental design components. Thirty instructors attended an inaugural 4-week workshop and formed the core of instructors for future workshops. Workshop instructors must teach network curriculum at public, 2-year colleges and are required to earn industrial network management certification. In order to receive a full stipend, workshop participants must pass industry examinations for certification.

ATE Site 6 has designed a model professional development workshop. Attended by high school and community college physics and science teachers and instructors, the workshop includes teaching techniques, innovations in materials, business needs and perspectives, and on-site experiences with companies in the technology area covered by the site. In addition to the camps, Site 6 is planning faculty internships and expanded funding for additional professional development training and travel.

ATE Site 7's ongoing professional development includes summer institutes and continuing opportunities for instructors to share ideas and to work with their peers and local industry representatives. Instructors report that the ongoing activities have enabled them to gain supplementary resources throughout the life of the *project*.

ATE Site 8 has provided technology training for full-time and some adjunct faculty members and has ensured that instructors are kept up-to-date through regular professional development training each year.

ATE Site 9 conducts summer professional development institutes and facilitates numerous meeting and activities designed to effect systemic changes in technological training program at secondary and postsecondary levels.

ATE Site 10 provides commercial courses and a series of workshops on curriculum, assessment tools, pedagogy, and networking. Instructors note their approval of the high quality of the professional development.

ATE Site 11 has ongoing training that is designed to emulate workplace situations and illustrate the principles of effective use/management of technology. Development of materials is continuing, and several sites serve as pilots for field-testing the materials.

ATE Site 13 has held more than 40 workshops in 7 regions, focusing on workplace experiences and expanding instructors' technology expertise. In addition, summer forums keep instructors up-to-date with biotechnology programs.

Element 2: institutional support. Institutional support is crucial to providing professional development. Current literature reports and some *project* sites confirm that community colleges have tended to undervalue faculty training. If staff development is to be

effective, administrators must take supporting action (Persky, 1990). Nine of the 13 ATE *projects* report strong institutional support.

At ATE Site 2, professional development is recognized as a high need by college administrators, but limited by available funding. The college is working with its county to assure future funding for ongoing staff training.

ATE Site 4 administrators have recognized that broad support is necessary to provide effective development opportunities. Having adopted a special program as an innovative concept of teaching and learning, the university has involved its division related to this program and distributed the workload associated with developing an innovative program. As a result, the division and the college both benefit. The institution is committed to implementing similar staff development programs throughout the university.

ATE Site 5 has initiated a professional development program that is on going, individualized, and hands-on, establishing an infrastructure to train instructors. Strong institutional support has enabled Site 5 to engage 110 public schools and 23 community colleges in workshops, impacting 67 percent of the state's 82 counties.

ATE Site 6 has worked closely with industry to establish an education-business alliance to address technology needs. The consortium's objectives are to respond in a coordinated fashion to the rapidly evolving industry requirements for a trained high-tech workforce and to share the limited educational resources to develop new training materials and laboratories.

ATE Site 7 has been encouraged by an industry needing technicians. Providing effective professional development is a stated goal of the college administrators and is galvanized by strong public support for its programs.

ATE Site 8 has provided funding for technical training of full-time and some adjunct faculty. While most colleges have limited professional development funds, Site 8 has worked to overcome the budget barrier by sending a limited number of faculty members to attend training and, then, to report to other instructors at monthly faculty meetings. All campuses have faculty who have certification training. Each Site 8 campus reinforces the importance of professional development by requiring a minimum number of hours each year, partly basing salary raises on staff training completed, and providing pedagogy and course/curriculum design workshops.

ATE Site 9 has supported professional development by making funding and time available to instructors to attend national meetings and workshops designed to help them develop their content expertise.

ATE Site 10 recognizes the need to provide professional development for its instructors. This support is reflected in the *project's* statement of intent: "to address the critical need for a well-trained workforce with the diverse skills needed in * technology." While faculty members note

the need for more release time for learning and working with complicated technology, they commend the training courses.

ATE Site 11 faculty praises the institutional support for the professional development they have received. Instructors rate their training as organized, effective, and useful.

Element 3: hands-on and classroom-based experiences. State-of-the-art professional development is hands-on and classroom-based. It requires the training and time for instructors to acquire, gain confidence with and, in turn, transfer new knowledge and skills to their students (Brand, 1997; Guhlin, 1996; Shelton & Jones, 1996). Eight of the 13 ATE *projects* report hands-on, classroom-based professional development.

ATE Site 1, believing that both instructors and their students will be more actively engaged by learning in an applied setting, has made classroom-based technical assistance the center piece of its professional development efforts.

ATE Site 3's professional development component emphasizes hands-on module user training and maximum exposure to new information and technology. In addition, faculty members are encouraged to "hear what is on the street" by attending the professional conferences of the industry.

ATE Site 4 summer internships for faculty are under discussion by local industry and the university. Faculty members have expressed interest and the program's industrial advisory committee has said it could support faculty internships. Among the issues to be resolved is scheduling so internships will not interfere with current teaching calendars.

ATE Site 5 has access to a dedicated laboratory to support the hands-on portion of staff training. Faculty members are increasingly taking advantage of the facility and the industry-training program for its curriculum. Site 5 has 11 2-year college education and training sites and 2 university education and training sites. Continued qualification training for 2-year faculty is available through the programs institutionalized by the colleges, including an academy, online courses, and short courses.

ATE Site 6 has designed a professional development program that includes on-site experience in industry production and lab facilities, interaction with industry representatives, and participation in internships.

ATE Site 7's professional development includes training institutes and follow-up meetings, but has also provided much hands-on experience or classroom-based assistance. While the institute exposed instructors to relevant technology content, it did so through tours and field trips to relevant technology facilities. Several instructors have expressed an interest in having professional development aimed at pedagogy, curricular materials they could use in their classrooms, and/or time to develop materials collaboratively.

ATE Site 12 has provided workplace experience for instructors through academies, as well as ongoing access to technological expertise and resources.

ATE Site 13 has focused on providing workplace experience and strengthening the technological know-how of its instructors. Concentration on the need for constant upgrading in the technology focus of the site has provided faculty members with exposure to and experience with current technology.

Element 4: individualized training. Individualized training ensures that instructors can learn new technologies and new instructional methodologies that are consistent with their current levels of expertise. The one-size-fits-all approach to training is not effective in education technology training (Browne & Ritchie, 1991; Shelton & Jones, 1996). Six of the 13 ATE sites report individualized training.

ATE Site 2 has provided professional development via workshops or credit or continuing courses. Faculty members have expressed a high level of satisfaction with the courses and have used the knowledge/skills gained in developing several technical courses. Given the diversity of the technical topics in the program, this individualized approach seems sound.

ATE Site 3 offers training in content areas that have been identified by instructors and are presented by trainers who are knowledgeable and current in the industry. To augment the introduction of new information and materials, previously trained colleagues share their ideas for using new materials in the classroom. The faculty-to-faculty workshops reinforce the ongoing nature of the Site's professional development.

ATE Site 5 has a self-paced professional development program that is designed to allow optimal learning and ensure the learner's confidence with new information and technologies before s/he attempts to teach the subject matter.

ATE Site 6 has designed a workshop specific to instructors' needs. Workshop activities include the industry perspective, aspects of the science involved in the Site's technology area, on-site experience with production and lab facilities, and discussion of techniques for integrating the technology area into classroom instruction.

ATE Site 9 conducts summer institutes that focus on instructor needs in terms of implementing new ideas and materials into their curricula.

ATE Site 12 has adopted 5 goals, one of which directly addresses individualized training: to provide workplace experience for instructors, along with ongoing access to technological expertise and resources, for the purpose of enhancing instructor knowledge and skills and ensuring classroom learning.

Element 5: follow-up training. Follow-up to training assures instructors that continuing advice and assistance are available as they implement new systems and techniques. Instructors must know they have support in adapting training content and applying new tools (Sparks & Hirsh, 1999; Guskey, 1999). All 13 ATE *projects* report follow-up activities.

ATE Site 1 is developing instructors' guides and workshops intended to expand opportunities of faculty members to access technical assistance on a continuing basis.

ATE Site 2 has established, in addition to continuing courses in the Site's technology area, a business/industry advisory board that assists faculty in defining changing technology competencies and developing new curricula.

ATE Site 3 has provided a strong communications network to support instructors and offers technical workshops throughout the academic year. In addition, faculty members are encouraged to attend national conferences, valued for their training opportunities and networking experiences.

ATE Site 4's approach to follow-up is 3-fold: to provide ongoing training for faculty members who want to change their instructional methods, to develop new criteria for teaching technological programs as instructors are added/replaced, and to make summer internships available for faculty members.

ATE Site 5 has been instrumental in creating a web-based program of study in its technology area. The target audience includes faculty pursuing skills and certification as NT instructors. The instructor component is available free-of-charge as part of Site 5's continuing professional development efforts.

ATE Site 6 has built an education-business alliance that ensures appropriated follow-up training activities by coordinating responses to evolving industry requirements and sharing limited resources to develop new course materials.

ATE Site 7 holds follow-up meetings devoted to developing articulation agreements that will ensure collaboration between secondary and postsecondary levels and promoting continuing professional development for high school teachers and community college instructors.

ATE Site 8 ensures that follow-up will occur through their faculty members who have certification in its technology area. These instructors are able to provide up-to-date technological instruction for their colleagues. In addition, workshops in pedagogy and curriculum design are provided through the Site's development program.

ATE Site 9 facilitates meetings and activities throughout the academic year that bring together various individuals and organizations. These events serve as a catalyst for professional development experiences for instructors.

ATE Site 10 encourages interaction between instructors by e-mail. Faculty members report that they share ideas and support each other on an ongoing basis.

ATE Site 11 provides continuing workshops for instructors to work on activities, modify teaching techniques, and hear how the *project's* technology area is used in business/industry settings. Suggestions for instructor participants in these follow-up sessions have resulted in production of a video of a business/industry scenario and annotated exercises to accompany instructional materials.

ATE Site 12 has a working education-business partnership that is committed to follow-up. The Site's intention is stated in its third program goal: to provide workplace experiences for instructors, along with ongoing access to technological expertise and resources for the purpose of enhancing learning.

ATE Site 13 acknowledges the importance of follow-up training and has set 4 objectives to direct its efforts: (1) continuing improvement of faculty technical skills, scientific knowledge, and pedagogical approaches; (2) bringing workplace experiences into the classroom; (3) developing selected courses and instructional materials; and (4) promoting and improving evaluation of program qualities and effectiveness.

Element 6: mentoring. Mentoring exposes faculty members to the experience of colleagues, provides a safe place to try out new ideas, and significantly increases development of creative instructional strategies (Stager, 1995; Tenbusch, 1998). Only one ATE *project* reports mentoring programs.

ATE Site 7 has included a summer institute and follow-up meetings in its professional development to explain the mentoring program, which includes a new externship for instructors.

Element 7: train-the-trainers. A train-the-trainers approach can expand training opportunities and alleviate the constant time and money problems faced by schools and colleges. In addition, faculty members who can act as trainers bring an important factor to professional development: They can identify their colleagues' current interests and needs and provide training that is specifically geared to address those interests/needs (Brand, 1997; Shelton & Jones, 1996). Four of the 13 ATE sites report using the train-the-trainers approach to expand professional development opportunities.

ATE Site 1 encourages instructors who have received technology training to train their colleagues, in turn, thereby expanding programs in their colleges. To make training more reliable and efficient, a train-the-trainer model is being developed by Site 1. A cadre of instructors from various institutions will be trained to implement the program at their respective schools and to become master teachers who train and assist others in implementing the program. Instructors' guides and workshops are in the planning stages.

ATE Site 4 curriculum reform has led to development of multiple applications in the college's departments and divisions and has occasioned the involvement of instructors as trainers for their colleagues.

ATE Site 5's workshops have involved instructional personnel from 110 public schools and 23 community colleges. Of the 289 faculty members trained, 224 were from public schools and 65 from 2-year colleges. Fifty-four of the 82 counties in the state have been impacted by Site 5 teacher development efforts. Site 5 estimates that more than 60,000 public school students and 25,000 2-year college students have benefited from the professional development received by their instructors.

ATE Site 8 has expanded the effectiveness of their professional development training through a train-the-trainers process. An on-campus trainer (a faculty member) provides training to colleagues and brings in industry representatives to provide up-to-date instruction in technological fields.

A comparison of Table 1 and the Outcomes table (Table 2) on the following page demonstrates a possible relation between the seven assessment elements and self-reported program outcomes. Joyce and Showers (1983) have offered a clear and concise rationale for providing the professional development that incorporates the seven elements recommended in this paper: "If education programs are to be effective, they require sustained, continual training efforts that are adequately funded."

Table 1: Extent of Professional Development Implementation

ATE Sites	Assessment Elements						
	Ongoing Training	Admin. Support	Hands-on Experience	Indiv. Training	Follow-up Training	Mentoring	Train the Trainers
Site 1	X		X		X		X
Site 2	X	X		X	X		
Site 3	X		X	X	X		
Site 4	X	X	X		X		X
Site 5	X	X	X	X	X		X
Site 6	X	X	X	X	X		
Site 7	X	X	X		X	X	
Site 8	X	X			X		X
Site 9	X	X		X	X		
Site 10	X	X			X		
Site 11	X	X			X		
Site 12			X	X	X		
Site 13	X		X		X		

Effects of Professional Development on Program Improvement in ATE

While current research tells us that each of the seven elements of effective professional development is important—because each incrementally increases the likelihood of successful training—it is unlikely that developing training programs will be able to incorporate all elements in their programs' early stages. Indeed, the ATE *projects* bear witness to the fact that some good results can occur without all elements present (though, the more, the better).

In general, visited sites' participants describe positive results from the training they have received. The outcomes noted by *project* staffs and program evaluators reinforce the notion that professional development can have positive effects, even if all elements of effective professional development are not present at a particular point in time. In the more detailed site descriptions appended to this report it is clear that many sites are planning to add other elements to further improve their professional development efforts. Notable outcomes are presented in Table 2 and are reported in more detail in the *project* summaries (see Appendix).

Table 2: Program Improvements as Reported by Sites 1-13

SITES OUTCOMES	1	2	3	4	5	6	7	8	9	10	11	12	13
Course Improvements	X	X				X	X	X	X	X	X	X	
Enhanced Knowledge of Technology	X	X	X	X	X	X	X	X	X	X	X	X	X
Increased Industry Understanding		X	X	X	X	X	X						X
Greater Networking Opportunities			X			X	X						
Student Success	X	X		X	X	X			X	X	X		
Program Sustainability	X	X		X	X	X							

These data indicate that ATE *projects* have succeeded in developing professional training programs that provide faculty and students with improved learning, enhanced technology skills, increased access to technology fields, and expanded opportunities to sustain long-term professional development. Notably, they have done this without a template; therefore, there are varying approaches. Nonetheless, the seven elements of successful professional development can be used as a metric to systematically assess professional development as employed within ATE sites. Participants also reported that professional development was beneficial to their improvement efforts and provided a good example from which to build stronger professional development initiatives in the future.

Facing the Challenges Ahead: Conclusions and Recommendations

The ATE program was developed out of a need to bring educational institutions of the type represented in this study up to world-class standards in technology. The rapidly changing pace of technology throughout the industrialized world and the lack of institutionally sponsored professional development were primary reasons the ATE program was introduced. It is clear that NSF-ATE funds have been instrumental in producing higher levels of professional development, as described above. Without NSF-ATE funds, the extent and quality of professional development made available to faculties would likely not have occurred (site staff interviews).

Time remains a central issue for program participants. Most teaching staff members have to use their own time in the summer or during nonteaching periods to participate in professional development efforts (staff interviews). As indicated earlier, educational institutions value instructor-student contact hours most. Time for planning, professional development, assessment, and reflection of instructional effectiveness are considered to be the responsibility of instructors, but not the educational institutions for which they work. This thinking, which has evolved over the years, has often resulted in less than effective training programs. When budgets become tight, institutional support for professional development typically declines and less time is spent on upgrading the skills and capacities of the teaching workforce. The rationale is that it is the responsibility of faculty to keep up-to-date on both content and pedagogy in their areas of specialization. This line of thought frees the educational institution from direct responsibility for providing professional development to upgrade skills and competencies. It also contributes to the gap between the growth of technological development and the abilities of community colleges and other educational institutions to meet the technological workforce needs of their communities.

On the other hand, it is clear that when community college administrators begin to see significant increases in student enrollment, they become more interested in providing resources to the departments with growing classes (administrator interviews). Funds for updated equipment and faculty development are looked upon more favorably when there is more student tuition to pay for them. In one institution, when students complained to the college president that there weren't enough computers to support their classrooms, several new computers appeared the next day (student interviews).

Similar reports from administrators, faculty members, and students in many sites indicate that college administrations need to be less reactive and more proactive in keeping their college and faculty current in rapidly changing technological areas, as well as providing them with the instructional tools they need to be effective. ATE has demonstrated that when faculty are provided the opportunity to increase their skills and develop courses that meet the needs of the technological community, they rise to the occasion and become much more effective in carrying out their educational responsibilities.

Data gathered through site visits and an annual survey of *projects* by the WMU evaluation project (Gullickson, Lawrenz, & Keiser, 2000) indicate that the ATE program has successfully

engaged associate degree institutions and others in developing materials and programs and providing professional development services to help implement them.

Recommendations for introducing and/or improving professional development programs are easy to make, but often difficult to carry out. Nonetheless, the authors presume to offer three suggestions for institutions with ATE programs that are originating or evolving.

First, perhaps the most difficult is also the most important: The primary requirement for successful staff training is institutional commitment. Support from the organization's leaders is crucial to the development, implementation, and sustainability of effective professional development. If the leadership does not truly believe in the concept of continuing education for everyone, then surely any training program will fail for lack of resources and interest. Therefore, the administration must understand and exemplify the value of professional development. In essence, they must create the teaching/learning environment in which lifelong learning is a reality.

It is probable that more research on the value of professional development at the community college level would provide the persuasive evidence needed by institutional leaders to provide the necessary program support. Current research is largely focused on staff training on use of educational technology at the secondary level and, while it is helpful in considering the various aspects of professional development, it needs to be reinterpreted in light of the special needs of postsecondary schools and instructors.

Second, a continuing test of commitment for schools and colleges is adequate funding to support the time needed for instructors to learn, experiment, and implement. Time and money: the two principal barriers to professional development are the proverbial horse and carriage. We cannot separate them from one another if we want to make progress. In terms of time, McKenzie suggests that 5 to 10 days a year are needed for instructors to gain the information and achieve the confidence to use this information in their classrooms. That is a significant number of days and a sizable commitment of resources for educational institutions that currently may provide only a few days or afternoons each year to professional development.

Without such an investment, however, staff training is probably a waste of time and money. Expecting instructors to engage in voluntary and unrewarded training programs is unrealistic. Continuing education needs to be a required part of the work year that gives instructors the professional development they want and need (McKenzie, April 1991). It is essential that postsecondary institutions find funding for the one thing that will enable them to reduce the digital divide between a technology-based economy and the colleges'/universities' ability to train students for the 21st century workplace: That thing is professional development for teaching staffs. A possible solution to the time/money problems faced by the college is implementation of the train-the-trainers approach.

Third, the final recommendation is the need to plan for assessment. It is imperative to know where you want to go in order to get there. Seven basic elements that make up effective training

programs have been used throughout this paper and may serve as a model for establishing or expanding professional development programs that result in enhanced teaching knowledge and skills. To repeat, those elements are: (1) ongoing learning and training, (2) institutional support, (3) hands-on and classroom-based experiences, (4) individualized training, (5) follow-up training, (6) mentoring, and (7) a train-the trainers approach to continuing education. It seems that we know what to do to achieve effective professional development; we must now define how to proceed at the community college level.

Despite the challenges we face in time, resources, and commitment, it is important that we persevere in providing quality professional development for instructors. To meet the demands of a rapidly changing society and economy, we need to think of continuing education as a substantial, long-term investment. That investment will bring us a committed teaching cadre and a well-prepared workforce. And that, after all, is what our efforts are all about.

APPENDIX: *Project* Summaries

The 13 site visit reports are the primary source for the following information. To ensure site confidentiality, as promised by the WMU evaluation project, references to specific technology areas that could lead to a site's identification have been omitted and replaced with a *.

ATE Site 1

The Site 1 *project* has developed a curriculum that introduces high school technical education students to the science technology used in chemistry, biology, physics, and earth sciences as applied in industrial settings.

Professional development is a central piece of the *project*, addressing ongoing efforts, program expansion through train-the-trainers procedures, and classroom-based technical assistance. Site 1 staff members have identified the need for instructors to receive initial and ongoing training as essential to effective program implementation and dissemination. In some cases, instructors who have received training have, in turn, trained colleagues, thereby expanding programs in their schools. To make training more reliable and efficient, a train-the-trainer model is being developed. A cadre of teachers and instructors from various schools and colleges will be trained to implement the program at their respective schools and to become master teachers who train and assist others in implementing the programs. Instructors' guides and workshops are in the planning stages. Site 1 also stresses the need of classroom-based technical assistance for teachers when and after they receive professional development.

This *project* has demonstrated the effectiveness of professional development for instructors and its impact on students: The latter are more likely to be actively engaged and interested in learning in an applied setting with up-to-date instructors. In the Site 1 *project*, students who were disinterested in school, in general, and in science, in particular, were "turned on" to learning as a result of their experiences. They gained knowledge and skills required by technological industries. Their achievements have been assessed and documented, based on both written tests and performance evaluation. The participating students should be prepared to move from secondary education to postsecondary institutions and/or the workplace, and ensuring student success is the goal of professional development in education technology.

The high level of instructor satisfaction with the program modules and positive student reaction bodes well for the long-term sustainability of the *project*. Site 1 has made a commitment to continued funding using royalties from instructional materials sales and a matching-dollar fund to support the program.

ATE Site 2

ATE Site 2 is working to enhance new certificate and associate degree programs with tracks in technology by providing stipends to faculty members for course development, a lab, a conference, and training for faculty members.

The college's professional development program is planned as an ongoing effort. The only questions are what form the training should take and how it will be funded. To date, college funds have not been sufficient to provide appropriate faculty training. ATE funding has provided access to professional development and future funding is assured from the Site's county.

Professional development has been provided via workshops or credit/continuing courses. Faculty have expressed a high level of satisfaction with the courses and have used the knowledge and skills gained in developing several technical courses. Given the diversity of the technical topics in the program, this individual approach seems sound to *project* evaluators.

The major impact of professional development has been to prepare faculty to create materials for the program. Faculty members who develop courses initially teach those courses, providing a simulated pilot test of the materials. Future course improvements will, no doubt, result from the efforts of the college faculty and several local high schools that are working together to develop articulated curricula.

To increase understanding of the industry, a business/industry advisory board has been established. The board assists faculty in defining technical competencies and guiding curriculum development. The board has proven to be invaluable in helping faculty understand industry trends and in identifying important knowledge and skills needed to assure employment in technology.

Strong support for the program comes from both the college and the county. Administration has backed significant funding for classroom/lab renovations and purchase of materials and software. The county has pledged funding for continuous professional development and other program needs. A major strength of the program and a positive reflection on both the college and its professional development is the students' views of faculty: Students describe their instructors as available, approachable, helpful, and "awesome."

ATE Site 3

Site 3 has set its goal as "the development of work-related, industry-endorsed curricula and instructional modules for use in community college programs primarily in * manufacturing." The professional development component of the *project* entails module user training, along with faculty attendance at national professional conferences and regional technical workshops.

Faculty members comment positively on the site's provision of a strong communication network and professional development opportunities. Of particular note, according to the instructors, are

the initial and continuing workshops—regionally held three- and four-day technical workshops given throughout the year and shorter workshops presented at national conferences. The conferences are viewed as valuable networking opportunities by faculty.

The site's staff connections with and knowledge of community colleges are credited with the high quality of the professional development, as are ties to industry's technology and needs. Workshops are presented in content areas that are needed by faculty and conducted by people who are knowledgeable and current in terms of the * manufacturing industry. Some faculty noted that when community college faculty members teach workshops they discuss how they present new materials in their classes. These workshops are described by the instructors as "faculty-to-faculty interchanges." They are not only content-oriented, but pedagogically-oriented as well.

The Site 3 professional development approach is designed to provide maximum exposure to new information and technologies in * manufacturing. The site tries to provide instructors with as many opportunities as possible to "hear what is on the street," hence, its strong support for continuing conference and workshop attendance. Keeping faculty members up-to-date is the best way to assure current classrooms.

ATE Site 4

The Site 4 *project* is designed to create and validate an innovative, replicable approach to preparing, placing, and maintaining high performance technicians capable of working on or with complex technologies or techniques in world-class, competitive, distinctive manufacturing firms. To accomplish the task, the *project* has adopted several professional development objectives:

- Increase the capabilities, sensitivities, and judgment of faculty and other resource persons to respect, support, and enhance the capacity of all students.

- Embrace the self-actualization needs of faculty and other resource persons as they modernize their philosophies about learning and strive to strengthen their mastery of the skills required for simultaneous process-oriented delivery systems, risk-taking, applied research, learner empowerment, and continuous quality improvement concepts.

- Continuously enhance the capacities of faculty and other resource persons to use emerging interactive technologies.

- Empower faculty and other resource persons to model the behaviors envisioned in a successful distinctive manufacturing technology environment.

Project evaluators have observed the professional development component and report that staff members have been provided assistance with adopting the new learning paradigm, but more is needed. Some staff members have been trying to adjust their teaching-learning philosophies from traditional textbook instruction and classroom settings to the more team-based *project*

approach; some have found the role change from instructor to facilitator and coach difficult to accept. Students have commented positively on the teaching transitions their instructors are making and have said that the instructors just need some time to be comfortable with the new methodology.

Professional work time has been provided for faculty to do work in the area of curriculum alignment and development. Ongoing training and support is given to faculty members who want to change their instructional methodologies, and continuing assistance is planned. As faculty members are added and/or replaced, the new criteria for teaching in the technology programs will be expanded.

Summer internships for faculty are under discussion by local industry and the college. Faculty members have expressed interest and the program's industrial advisory committee has said they could support faculty internships. Among the issues to be resolved is scheduling for internships that will not interfere with current teaching calendars.

Institutional support is key to ensuring professional development programs and is viewed as a central element in the Site 4 *project*. College administration has recognized that the flagship program's concept of teaching and learning requires broad support. By infusing the new philosophy throughout the division, the workload associated with learning about and developing an innovative program has been more equitably distributed. As a result, the entire division and the college benefit. In fact, the curriculum reform resulting from the program has led to development of other applications in the college's departments and divisions. The institution is committed to completing the transformation to all programs of the college.

Interviews and site visit observations indicate early student satisfaction with the program. A program retention rate of more than 90 percent is significant, as is the fact that the program's industrial partners give it high marks. Such support from the industry should enhance student interest and provide the impetus for high student achievement.

The college president has been a driving force behind initiation of the program, and he has stated his intention of maintaining it. Resounding endorsements from industry representatives suggest program institutionalization at the college and long-term training support from the industry. Continuing planning and change will be necessary, however, to provide financial support for faculty development and to permit release time for faculty to develop curricula and serve internships.

ATE Site 5

Site 5 has set a notable and achievable goal: to embrace existing and emerging technologies and integrate them into the 2-year college environment, and to establish an infrastructure to train secondary teachers and postsecondary instructors in * technologies.

The *project* initiated a three-year training program designed to be ongoing, individualized, and hands-on. Workshops model curriculum components and laboratory environmental design components. Thirty instructors attended an inaugural four-week workshop and formed the core of instructors for future workshops. These workshop instructors are required to teach * curriculum at a public two-year college and to obtain industrial * certification. Workshop participants receive either CEUs or graduate credit. To receive a full stipend, the participants have to pass industry examination for certification.

Professional development is self-paced to allow optimal learning and ensure the faculty members' confidence with new information and technologies before they attempt to teach the subject matter. To provide continuing information and training, site staff has helped to create a Web-based program of study in *. The target audience includes faculty pursuing skills and certification as * instructors. The instructor component is available free of charge as part of the *project*'s continuing professional development efforts.

The site has a dedicated laboratory to support the hands-on portion of training. Faculty members are increasingly taking advantage of the facility and a training program for * curriculum. Site 5 has 11 2-year college education and training sites and two university education and training sites. Continued qualification training for 2-year faculty is available through the *project* and includes an academy, the Web-based program, and short courses.

Instructional personnel from 110 public schools and 23 community colleges have participated in the workshops. Of the 289 faculty members trained, 224 were from public schools and 65 from two-year colleges. Fifty-four of the 82 counties in the state have been impacted by teacher development efforts. Site 5 estimates that more than 60,000 public school students and 25,000 two-year college students have benefited from the professional development received by their teachers.

Despite these successes, further training is needed for teachers in grades 8 though 12 (The Department of Education estimates 300 or more teachers need network training). While new equipment is being funded by the state, only minimal funds have been identified for professional development. A possible solution to the funding gap is to direct an * instructor qualification effort toward school districts' technology coordinators who could train the teachers in each district. The site could serve as facilitator and provider of such a train-the-trainers undertaking.

To date, 80 percent of professional development workshop participants have received industry certification, including more that 80 community college faculty who are teaching * courses. When compared to the only other source of training available for community college faculty—private vendors—Site 5's college-based training is significantly more productive. Sixty-five percent of secondary teachers and 100 percent of 2-year college instructors passed the certification tests, compared to the 40 percent pass rate of teachers who attended private commercial courses.

Professional development and course improvements can be credited, at least in part, for increased enrollment in technology programs and greater graduation rates. The site's * technology program is the fastest developing and largest program in the school, having increased from 15 students in 1997 to 159 technology majors in 2000. Approximately half of those students transfer to 4-year colleges to continue their education. Job placement rates for community college graduates are 80 percent and higher.

Site 5's professional development will serve as a model for the state and the region. Continuous training will be provided and sustained through fees charged to participants.

ATE Site 6

The goal of the Site 6 *project* is to design and deliver a collaborative, replicable * workforce development system that maximizes learning for secondary and lower division students through coordinated sharing of industry and educational resources.

The community colleges and universities that are part of the Site 6 *project* have worked with industry to establish an education-business alliance. This consortium's objective is to respond in a coordinated fashion to the rapidly evolving industry requirements for a high- tech trained workforce and to share limited education resources to develop new course materials and laboratories to train the high-technology workforce that is needed.

The *project* has proposed to demonstrate significant annual increases in enrollment, persistence, retention, completion, and placement rates among participating students. In fact, the *project* set 10 percent increase targets. In order to achieve the desired increases, Site 6 has designed a model professional development activity to prepare instructors. The workshop is designed for high school and community college science instructors. Activities deal with the business perspective of the basic aspects of the science involved, the materials and manufacturing process, and process control requirements. The workshop also includes tours of production and lab facilities, discussion of ways to integrate the technology area into the classroom, and an overview of career opportunities for students. The camps will continue.

Faculty internships are planned, as is development of funding for continued professional development training and travel. The industry knows that knowledge and skills must stay current with industry needs, and the consortium is dedicated to sustaining a professional development component that will support those needs.

ATE Site 7

The primary goal of the Site 7 *project* is to create an articulated * technology curriculum at the secondary level that adds to the already established technology 4-year degree, 2-year degree, and year-long certificate program at the community college. Professional development is a key part of the Site 7 *project*.

The *project*'s professional development includes a 4-day summer institute, follow-up meetings intended to explain the mentor/mentee program, and the articulation agreements for 3 tech prep courses. Twelve teachers from 11 of the 16 area high schools have attended the institute; approximately half of the attendees are working on articulation agreements. All attendees named collaboration as a strength of the summer institute, and all reported that they used materials and/or information from the institute in their courses. Teachers and college instructors were able to share ideas, work with other faculty members who teach corresponding courses, and establish contacts with local technology facilities. They also gained resources (textbooks, web site information, references for * educational materials) and an opportunity to participate in an externship.

Despite some exposure to pedagogy and new technology content knowledge, the site visit team suggests that such professional activities could be improved. For example, training did not provide teachers or community college instructors with curriculum materials they could use when they returned to their classrooms or with the time to develop such materials collaboratively. While the institute exposed instructors to * technology content, it did so through tours and field trips to * technology facilities. Several of the instructors expressed an interest in having professional development aimed pedagogy, i.e., how to teach * technology using learner-centered, high-quality instructional techniques recommended by the *National Science Standards*.

The *project* met its stated goals, but the goals are written in a nonspecific manner. For instance, the goal to have a summer institute for professional development is very general. The institute provided a good introduction to the courses offered, but future sessions could specify content knowledge, pedagogical knowledge, and curriculum development opportunities for high school teachers. Providing effective professional development is encouraged by an industry need for * technicians, as well as by the strong college administrative and public support for similar programs in the Site 7 area.

ATE Site 8

A joint effort of 7 community colleges and more than 70 high tech * technology employers, Site 8's goal is to develop a regional approach to the preparation and training of * technicians to meet the high demand for qualified technicians. As a central part of this effort, Site 8 strives to provide professional development for instructors who specialize in * and * technology.

An ongoing issue of concern is how to provide professional development for faculty who will teach the technicians. Many college campuses have very limited professional development funds; most report $400 allocations for each faculty member for as long as funds last. Considering that * training classes cost $1,200+ just for tuition, the professional development budgets are woefully inadequate. Time to engage in professional development is also hard to come by. Nonetheless, Site 8 has been able to provide the funding through the ATE grant for technical training of full-time and some adjunct faculty and to expand the effect of training through a train-the-trainers process. All Site 8 campuses now have faculty who have * certification training.

This consortium of community colleges also uses a number of adjunct faculty to deliver technology courses. More frequently than not, only one full-time faculty member is responsible for his/her campus' technology program, and s/he engages people who work in the industry to provide up-to-date instruction in the rapidly changing technology fields. Pedagogy and course/curriculum design workshops are provided by the community colleges' development programs.

As part of regular professional development, the colleges require a minimum number of professional development hours each year, and faculty members say that salary raises are determined, in part, by the number of college credit courses completed (College credit courses are considered to be an indication of professional development). A cause of frustration for * technology faculty is the fact that many training programs in * technology are provided by the industry or service providers without offering college credit. This places a double burden on * technology faculty—a need to fill professional development requirements with courses that may not be germane and a need to obtain technology training without credit or remuneration.

Funding is the most critical issue for providing appropriate professional development in technology and for the continual upgrades in faculty expertise needed in a constantly changing field. Faculty members report that Site 8 funds have enabled them to get the training and develop courses and curricula that would not otherwise have been possible. Unfortunately, the consortium has no current strategy for providing continual training funds for faculty in the rapidly changes areas of technology. Possible funding targets are tech prep initiatives and the VETA (Vocational Education Technical Act).

ATE Site 9

Site 9 has undertaken a *project* to link partners in education, research, industry, government, professional societies, and others to effect systematic change in associate degree programs in advanced technologies. It is a goal of the *project* that graduates will enter the workforce and/or continue their educations in science-based occupations.

The primary professional development occurs at the Site's summer institutes for high school teachers, community college instructors, and 4-year college/university professors. In addition to the summer institutes, Site 9 facilitates other meetings and activities designed to bring together

various organizations and individuals, serving as a catalyst for professional development experiences for faculty members. An external evaluator's report confirms the participants' statements that the summer institutes have been well received. Participants report implementing ideas or materials from the institute. The bulk of professional development has concerned curricular development and has been achieved by providing funding for faculty to attend national meetings or training sessions to help them enhance their content expertise.

A focus of Site-sponsored high school teacher training is on building community-based programs. Expectations at the high school level may be somewhat unrealistic in terms of time and effort. Most secondary faculty members have neither the resources nor the support mechanisms that will allow them to undertake community-wide alliance building.

Despite the generally high marks the Site receives from participants in professional development activities, no one interviewed thinks that those activities will be sustained after funding ceases. Interviewees indicate that dissemination of course and curriculum materials will probably continue only as long as they are relevant and, then, only if a means to support dissemination can be found.

ATE Site 10

The Site 10 *project* intends to "address the critical need for a well-trained workforce with diverse skills in * technologies." To prepare this workforce, the *project* recognizes the need to prepare instructors and has provided commercial courses in *, along with a series of workshops.

Faculty members have expressed high degrees of satisfaction with the training courses, but mention the need for release time to allow faculty members sufficient time to learn and work with complicated technologies. Other professional development sessions have been held to discuss curriculum and assessment tool design, pedagogy issues, and * projects. Faculty have mixed reactions regarding the usefulness of these sessions, preferring to focus on the task at hand—developing curriculum and implementing programs. Continuing development has included interaction between instructors by e-mail, who have shared ideas and supported one another.

Assessment of the *project*'s professional development has consisted of looking at the levels of satisfaction with workshops and other training activities. However, to know the real effectiveness of the development program, evaluation needs to be targeted at measuring use of what was learned and, eventually, the impact on student learning.
Site 10 would benefit from employing the 7 basic elements of professional development as a planning and assessment tool.

ATE Site 11

The Site 11 *project* has been developed to produce laboratory exercises that mirror workplace problems and illustrate principles related to *. Site 11 has undertaken development of materials,

and several other community colleges are sites for piloting and field-testing the laboratory materials.

Faculty members from cooperating institutions have attended two- and three-day workshops on two occasions. Participants spent the workshops working on activities, modifying activities for their campuses and classrooms, and hearing presentations by business/industry representatives about how the Site's technology area is used in their settings. Suggestions from participants have resulted in production of a video of a business/industry scenario and annotated exercises to accompany instructional materials.

The professional development component of this *project* has been rated as effective and useful by attendees. *Project* staff members have been more critical of their efforts, stressing that they are still incorporating ideas for improvement. In general, the *project*'s professional development element seems organized and efficient. An area for possible improvement is help for faculty in implementing materials they learn about at the workshops. Mentoring would greatly aid faculty in their implementation efforts.

ATE Site 12

Site 12 is a working education-business partnership. The consortium is made up of 4 institutions of higher education, 2 * consortia that include 75 secondary schools, and several area industries. The alliance has adopted 5 goals for its 3-year *project*, which are to:

1. Initiate community-based programs to increase the number of students preparing for technology careers, especially those students who are traditionally underrepresented
2. Develop curricula and instructional options that align math and science coursework with industry standards-based requirements and ensure secondary-postsecondary linkages
3. Provide workplace experiences for instructors, along with ongoing access to technology expertise and resources, for the purpose of ensuring the relevance of students' classroom learning
4. Address the career advancement needs of mature learners to assimilate knowledge of converging technologies in their workplaces
5. Share successful instructor recruitment and retention programs, tools, and curricula statewide and nationally

Project evaluators found considerable strength in a number of the Site's program elements: collaboration; course, curriculum, and materials development; program improvement; recruitment; and program sustainability and transferability. Unfortunately, professional development has not received equal attention; however, the site team reports that the * academies provided a professional development element. Conferences familiarized people with the nature of the program. Workshops and in-service classes held at the secondary and 2-year college levels served to implement local * academies and teach the * program. Four faculty members have attended workshops sponsored by local industry. Also, 11 students (employees

of the company) have completed the program and have received promotions to technical positions in the company.

The evaluators identified 2 central deficiencies in the Site 12 *project*: limited professional development and a lack of understanding of NSF's supporting role. Concern for the latter goes beyond omission of credit to NSF in this particular *project*. It extends to the possible misunderstandings about NSF's role in responding to and supporting technology needs in education and the workplace and, in turn, to potential reductions or elimination of the federal funding that supports advanced technology education programs.

In the case of the lack of attention to professional development, the research has long stressed the potent difference staff development can make in the performance of both instructors and students. If education programs are to be effective, they require sustained, continual training efforts that are adequately funded (Joyce and Showers, 1983). Anything less threatens the viability of the program. Professional development remains an unfulfilled aspect and needs to be addressed in order to achieve Site 12's goals.

ATE Site 13

The *project* is organized around the principle that a national network of programs in * at community and technical colleges will have three important results:

1. Enhancement of effective actions on the local level
2. Assurance of maximum impact of collective action at the national level
3. Provision of a broad distribution of resources and information

The *project*'s goals are fourfold: to provide support for * students and technicians, to improve instruction and learning, to share information and resources, and to foster collaboration and partnerships. In the area of instruction and learning, objectives include:

- Improving faculty technical skills, scientific knowledge, and pedagogical approaches
- Bringing the workplace experience into the classroom
- Developing selected courses and instructional materials
- Promoting and improving evaluation of program quality and effectiveness

Professional development is one of the *project*'s goals, focusing on providing workplace experiences and strengthening the expertise of high school and college technical instructors. Throughout 1999 and 2000, more than 40 workshops were held in all 7 regions, serving some 1,000 teachers and industry representatives. In addition to the regional workshops, the site organized summer forums for 71 * educators. Stipends have covered costs for registration, housing, and per diem for participants. Instructor internships and workshops for high school students have also been part of the *project's* activities.

Beyond providing exposure to and experience with * for instructors and students, the workshops have been intended to concentrate broad awareness of * and technical upgrading. While presentations have attracted participants nationwide and have been given high-quality feedback, the program evaluators have expressed three concerns:

1. That the material at the workshops may not be explicitly transferable to the classroom and/or laboratory setting
2. That the evaluations of the effectiveness of the professional development activities has been subjective with data collection limited to how the participants felt
3. That the evaluations may not be used to improve the activities.

Site reviewers note that, overall, the *project* is making progress on all of its goals. The reviewers, however, have made some recommendations specific to the professional development goal. These are to:

- Move from measuring participant satisfaction to measurement of what was learned and the eventual impact on student learning in order to determine the effectiveness of the workshops
- Develop in-depth, specific, and systematized data collection procedures, including students enrolled in * programs, demographics of students enrolled, and percentages of students who find employment in the field
- Establish benchmarks against which to assess progress

Given the evidence that the demand for * technicians across the country far exceeds the supply, Site 13 has an excellent opportunity to support exemplary programs with multiple capacities. The challenge before the site is to provide professional development that is designed to meet instructor-identified needs; ensure activities that include ongoing staff training and mentoring; and link the classroom-laboratory and the workplace-laboratory. In so doing, the Site 13 will ensure a skilled and diversified workforce prepared to meet new needs.

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