



## APPLE CLASSROOMS OF TOMORROW

Creating an Alternative  
Context for Teacher  
Development:  
The ACOT Teacher  
Development Centers

Authors  
Cathy Ringstaff  
Keith Yocam  
*Apple Computer, Inc.*

ACOT Report #18

# Research

**A**pple Classrooms of Tomorrow (ACOT)<sup>SM</sup> is a collaboration—initiated in 1985—among public schools, universities, research agencies, and Apple Computer, Inc. In ACOT classrooms, students and teachers have immediate access to a wide range of technologies, including computers, videodisc players, video cameras, scanners, CD-ROM drives, modems, and online communications services. In addition, students can use an assortment of software programs and tools, including word processors, databases, spreadsheets, and graphics packages. In ACOT classrooms, technology is viewed as a tool for learning and a medium for thinking, collaborating, and communicating.

ACOT's research has demonstrated that the introduction of technology to classrooms can significantly increase the potential for learning, especially when it is used to support collaboration, information access, and the expression and representation of students' thoughts and ideas.

Realizing this opportunity for all students, however, requires a broadly conceived approach to educational change that integrates new technologies and curricula with new ideas about learning and teaching, as well as with authentic forms of assessment.

*This report describes the first year in an innovative staff development project that assists teachers as they learn to integrate technology and move toward a more constructivist approach to teaching.*

*Although research indicates that technology can support and facilitate constructivist learning, and act as a catalyst for change, teachers need more support than is typically provided.*

## The Need for Reform

Calls for reforming today's schools frequently focus on the need to reemphasize student problem-solving and higher order—thinking skills (Holmes Group, 1990; Carnegie Forum on Education and the Economy, 1986), an emphasis that will require a dramatic shift in the form of instruction that is routine in American classrooms. Children need frequent opportunities to “critically evaluate what they read, express themselves clearly in verbal and written forms, and be comfortable with various forms of technology that can serve as tools for thinking” (Brown & Campione, 1990). To facilitate the development of these skills, learning and teaching must shift from a knowledge-transfer process—instructionism—to a knowledge-building process—constructivism (Collins, 1991; Sheingold, 1991). In constructivist learning environments, learning is more collaborative and less didactic. Students are actively engaged in constructing their own knowledge, rather than passively memorizing facts.

Research investigating the impact of technology on learning and teaching suggests that technology can support and facilitate constructivist teaching (Sheingold, 1991; Collins, 1991; Fisher, 1989). For example, in classrooms with technology, researchers have documented a shift away from directed teaching (Dwyer, Ringstaff & Sandholtz, 1991; Schofield & Verban, 1988); a move toward a more cooperative social structure (Dwyer, Ringstaff & Sandholtz, 1991; Brown & Campione, 1990); and greater emphasis on assessing student products, progress, and effort (Schofield & Verban, 1988).

Although technology can serve as a catalyst for teacher change and can help teachers move toward a more constructivist approach, the professional journey from instructionism to constructionism—and to effective integration of technology—is generally slow and arduous, and requires a high level of support. Typically, teachers begin using technology to replicate old patterns of instruction; it is often years before they progress to the stage in which they truly integrate technology and use these tools to their fullest potential. In some cases, teachers do not move far beyond using technology for drill and practice (Ringstaff, Stearns, Hanson & Schneider, 1993).

Movement toward technology integration, and toward more constructivist modes of teaching, is often slow or nonexistent because staff development typically offered to teachers is inadequate. Frequently, teachers are given short workshops after school, shown how to hook up and operate their equipment, and then sent back into their classrooms with little or no follow-up support. This paper describes the creation of an innovative model of staff development that was designed to assist teachers as they learn to integrate technology and move toward a more constructivist approach to teaching.

*The ACOT Teacher Development Center project establishes an innovative model of staff development that goes beyond traditional teacher in-service training.*

*The design of the project is based on the premise that adult learners, like children, should be given the opportunity to construct and interpret meaning for themselves, rather than being "fed" information.*

*Because participating teachers observe and work with ACOT teachers and students during actual school days, they have a framework in which they can examine the results of what they're learning.*

## Creating a New Model of Staff Development

An unusual partnership was created in the fall of 1992 when the Apple Classrooms of Tomorrow (ACOT), three school districts, and the National Science Foundation (NSF) joined to create the ACOT Teacher Development Center project. Three teacher development centers were created in schools where ACOT has already made major investments in technology, teacher support, and professional development. In ACOT classrooms, students and teachers have immediate access to a wide range of technologies, including computers, videodisc players, video cameras, scanners, CD-ROM drives, modems, and on-line communications services. In addition, students can use an assortment of software programs and tools, including word processors, databases, spreadsheets, and graphics packages. In ACOT classrooms, technology is viewed as a tool for learning and a medium for thinking, collaborating, and communicating.

The ACOT model of teacher development was created by a steering committee composed of ACOT teachers, district leaders, research advisors, and ACOT staff from Apple headquarters. Together, they designed a staff development program that goes beyond the traditional teacher in-service experience. Participating teachers learn by observing and working with accomplished ACOT teachers and students during actual school days. ACOT calls this situated teacher development, because participating teachers are situated in a context of practice. Unlike typical after-school in-services, this model of teacher development allows program participants to see expert teachers modeling instructional practices as they work with students, thereby providing participants with a framework in which they can examine the results of these practices on student work and interactions.

The centers also differ from traditional forms of staff development because activities are learner-centered and interactive. The design of the project is based on the premise that adult learners, like children, should be given the opportunity to construct and interpret meaning for themselves, rather than being "fed" information. The project's constructivist design models the types of learning environments implemented in ACOT classrooms.

The Teacher Development Center project has two major components: week-long practicums during the school year and four-week summer leadership institutes. At the centers, teachers learn about integrating specific hardware and software into their instruction, and have the opportunity to explore issues such as interdisciplinary instruction, alternative assessment, project-based teaching, and team teaching. Both the practicums and summer institutes require participants to implement technology-related projects in their own classrooms. After attending a practicum and/or summer institute, teachers receive follow-up support from project coordinators on an ongoing basis.

*Data were collected during the first year of the three-year project. Data sources included interviews, observations, questionnaires, and participants' and coordinators' journals.*

## Overview

This paper describes the creation of three teacher development centers, and reports on the lessons that we have learned about technology integration, teacher professional development, and adult learning in general during the first year of the project. Specifically, this paper focuses on these questions:

- What are the vital features of a staff development program that effectively models the type of constructivist learning environment we believe teachers should be implementing when they return to their classrooms? In other words, how can we help teachers employ technology to construct their own knowledge about using technology effectively for instruction?
- What qualities characterize a learning environment where teachers can acquire the skills they need to integrate technology into their classrooms effectively?
- What types of barriers exist that impede the development of such a program? What types of supports are necessary?

## Methodology

This qualitative study relied on the following sources of data:

- Pre- and post institute interviews with a sample of participating teachers and ACOT teachers, as well as with all three program coordinators
- Observations and unstructured interviews at each site
- Pre- and post institute teacher questionnaires
- Participating teachers' and coordinators' journals

Pre-institute questionnaires focused on assessing teachers' level of expertise and experience with using various technological tools, alternative assessment strategies, team teaching, and collaborative/cooperative learning strategies. Observations and unstructured interviews focused on assessing teachers' reactions to various components of the program, and documenting their concerns. Postinstitute questionnaires asked teachers to evaluate issues such as program structure, organization, and pacing.

## Project Description

### The Sites

The Teacher Development Centers are located in three schools that serve different socioeconomic populations: a suburban elementary school in the Bay Area of Northern California, an urban high school in a large city in Ohio, and a suburban elementary school in Tennessee.

### Site A

This school district comprises 18 elementary and 4 junior high schools, and serves more than 13,000 students, 35 percent of whom are Asian, Hispanic, or African-American.

*The Teacher Development Centers are in three different locations across the country. Participants who came from the local school districts, had widely differing backgrounds in terms of both technology and teaching experience.*

#### Site B

This district serves approximately 64,000 students, and has a minority population of almost 52 percent. The district, which includes schools at the elementary, middle, and secondary levels, employs almost 5,000 teachers.

#### Site C

Enrolled in this school system are over 71,000 students in more than 120 schools. The minority population in the district is almost 45 percent and includes African-Americans, Hispanics, Asians, and Native Americans.

### The Participants

During the first year of the Teacher Development Centers project, participants were recruited from the three schools and districts in which the centers are located. At Site A, participants came from the preschool, elementary, and junior high levels, and included some special education and English as a Second Language teachers. Attending Site B were teachers in kindergarten through 12th grade. At Site C, there were K–6 teachers from the regular elementary program, from special education, and from Chapter I, as well as resource teachers who serve a variety of grade levels. The middle school and junior and senior high school teachers who attended at Sites A and B represented a variety of disciplines, including math, science, language arts, social science, physical education, and foreign language.

Participants' teaching experience varied widely; there were a handful of novice teachers, as well as a small percentage of teachers with over 30 years of experience. Teachers' technological knowledge and expertise varied, as well. Although there were some teachers at each site who had never used a Macintosh computer before, there were others who rated their proficiency with technology as "high" as compared with other educators in their school. Those who were already using technology before attending the Teacher Development Center were most likely to use computers, instructional television, and VCRs in their classrooms. Very few had used a CD-ROM drive, an LCD panel, a videodisc player, a modem, or a scanner. Most reported that they were totally unfamiliar with, or were just beginning to learn, more sophisticated uses of the technology such as multimedia, telecommunications, spreadsheets, and HyperCard.®

### Differences Across Sites

The Teacher Development Center program was specifically designed to be flexible, so that each site could make modifications based upon the needs of individual participants, as well as particular district strengths and constraints. By design, the Teacher Development Centers project does not offer a specific "model" of staff development that can simply be replicated, but rather a framework from which others can build teacher development programs. Within certain parameters, the coordinators at each site were given freedom to make changes as the program evolved. Consequently, the programs at the three sites differed in a variety of ways. The following sections describe the practicum and the summer institute as well as some of the differences across sites.

*Instead of a specific model of staff development, the project offers a framework that can be modified to meet the needs of the participants and the strengths of the coordinators. At one site, the coordinator had spent three years developing the pilot program. As a result, the basic structure of the week-long practicum was relatively fixed.*

## Practicum Structure

At each site, practicums differed in terms of their overall structure. At Site C, which had the most highly structured practicums, the coordinator had piloted a staff development program similar to the ACOT model of teacher development for three years before receiving funding from NSF. During these pilot years, she had made modifications to the program, and by Year One of this project, had settled on an overarching agenda that worked at her site. The basic structure, which varied little from practicum to practicum, included the following:

- The first and second days of the practicum focus on providing participating teachers with an introduction to the Teacher Development Center, as well as to the ACOT project in general. Teachers are also given an extensive amount of time to observe what is occurring in ACOT classrooms. On a number of occasions throughout each day, teachers meet together to discuss what they have observed. Demonstrations of particular pieces of software and hardware are also conducted .
- Although observations and demonstrations in ACOT classrooms may also occur on the third and fourth days of the practicum, the primary focus during these days is on helping the participants transfer what they have learned to their own classrooms. Participants meet with the coordinator individually to begin planning projects that they will implement upon returning to their school, while the other teachers look through catalogs of software, and experiment with the available hardware and software.
- On the final day of the practicum, participants complete their individual proposals with the assistance of the coordinator. If time permits, teachers can continue individually exploring the technology.

Although this basic structure remained the same from week to week, no two practicums at Site C were exactly alike, since the schedule was kept flexible, and the coordinator altered the flow of activities in response to both what was happening in the classroom and what was happening with the practicum teachers. For example, if the practicum teachers expressed interest in an issue or a piece of equipment that was not part of the planned presentation, the coordinator changed her presentation. Similarly, the coordinator scheduled more time than usual in the special education classroom when two participants came to the practicum who are teachers of students with special needs.

In comparison, the process of designing and implementing practicums was a learning experience for the newly hired coordinators at the other two sites. Experimenting with different formats, they made adjustments to the basic structure of the program from week to week, based on feedback from the on-site researcher, from the practicum participants, from ACOT teachers, and from ACOT staff from Apple headquarters. One example of a major change that occurred to the basic structure of the practicums at these two sites relates to the amount of time and attention that was devoted to discussing the constructivist teaching philosophy that underlies the program.

*At the two sites with new coordinators, the structure of the week-long practicum evolved as the coordinators became increasingly familiar with their roles and the participants' needs.*

The coordinator at one site, for example, describes the first few practicums she conducted as “very different” from the practicums held toward the end of the year. At first, she spent much of her time demonstrating hardware and software and giving participants hands-on training—playing a role with which she was comfortable, given her extensive experience as a technology resource teacher. The coordinator explained that, though she used a constructivist approach when she was a classroom teacher, she was not as experienced in talking about this philosophy to the participants. New to ACOT, she said that she “didn’t have the words for it, or the big picture.” In a short time, however, she “started understanding the program’s priorities” and made the philosophy the “focus point” of the week. By the fourth practicum, the coordinator decided to start each day with a discussion of pertinent research literature, and she made time each day for the teachers to reflect on what they had seen while observing in project classes. In this way, the coordinator successfully shifted the program’s emphasis away from “nuts and bolts” technology training to a concentration on the issues related to technology integration, teacher and student roles, alternative assessment, and other elements of constructivist teaching.

Another coordinator stated that there was a similar shift in focus during the practicums at her site. During the first few practicums, she sent the teachers into project classes with only a general introduction to what they might be seeing. For example, she might tell teachers, “Today, in Mr. Smith’s class, students are using Geometric Supposer.” Not surprisingly, when participating teachers engaged in group discussions about what they had seen while observing in project classes, they focused almost exclusively on hardware and software issues. According to the coordinator, teachers often did not notice the more important elements of the ACOT environment, such as student collaboration or project-based instruction.

After some time, the coordinator decided to change her strategy for focusing classroom observations. Before teachers visited the project classrooms, she led a detailed discussion about instructional strategies, teaching styles, and educational philosophies. Through this discussion, the participants developed a list of instructional features to look for while observing. According to the coordinator, this strategy—which she calls “peeling away the layers of constructivism”—enabled participants to develop a “shared vocabulary” for important terms such as “collaboration” and “interdisciplinary teaching.” During the five days of the practicum, this shared vocabulary was a vital element in group discussions about constructivist teaching, and it helped shift attention more toward philosophical issues.

*Four-week summer institutes were conducted at each site. Participants interacted with students and project teachers, learned about new technology, participated in group discussions, wrote journal entries, and developed plans to integrate technology in their own classrooms.*

*At Site A, students in grades K–5 worked on ecology projects. Institute participants were actively involved in the classrooms, either presenting lessons or working with individual students.*

## Summer Institute Structure

Although the summer institute at each site lasted the same amount of time—20 days—each institute differed in a variety of ways, including:

- Amount and type of teacher participants' interactions with project teachers and students
- Structure of daily activities
- Setup and use of available technology
- Participant selection
- Level of student participation
- Coordinator's role

### Site A Summer Institute

At Site A, attendees came in two-teacher teams from schools throughout the district, and half of the group had already attended a week-long practicum. Each team had to supply one Macintosh® LC computer; the other team member used a computer donated by Apple.

At this site, the summer institute was held in conjunction with a summer enrichment program for students in grades K–5, which was run by a local community college. Students, who paid \$295 to attend the four-hour-a-day, four-week program, worked with one of four ACOT teachers on ecology-related projects while learning how to use various technological tools. Enrollment was limited to 24 students per class, and demand was high enough to fill all four project classes. The Teacher Development Center summer institute began three days earlier than the students' program, so teachers could receive basic training on the Macintosh and meet with the ACOT teachers.

ACOT teachers had responsibility for designing and implementing the curriculum for the summer school students, as well as for working with the visiting teachers. Each week, six participating teachers were assigned to work with each ACOT teacher and her students in the classroom for about two-and-a-half hours each day. While in the classroom, participants worked actively with students, sometimes presenting whole-group lessons, and other times working with individual students or small groups. In order to expose the teachers to a variety of age groups and ACOT teachers, participants' classroom assignments were changed three times over the course of the summer institute.

While they were not in ACOT classrooms, participating teachers spent a great deal of time receiving hands-on technology instruction. Although the coordinator generally decided on the training agenda for the day, participants could also request instruction on specific equipment or software. Time was also allocated during the summer institute for teachers to individually explore hardware or software that they found interesting. Each teacher had his or her own computer, which was set up in a central location in the school.

*At Site B, where students were primarily ninth-graders who would be enrolled in the ACOT program in the fall, Institute participants and students collaborated on various projects.*

More often than not, technology training was conducted by one of the participating teachers, rather than the coordinator. In this school district, many of the teachers are quite knowledgeable about technology, so the coordinator purposefully drew on participants' individual strengths and stepped back into the role of facilitator. Sometimes, participants were asked to learn about a new software package and present what they had learned to the entire group on the following day. Other times, ACOT teachers told participants that they would be responsible for teaching students how to use a piece of hardware or software, and participating teachers had to "scramble" in order to "stay one step ahead of the kids." In some cases, teachers learned about the technology from the students, who often knew more about the tools than the teachers.

On a daily basis, teachers also participated in group discussions in which they shared their ideas and experiences. The coordinator chose a different participating teacher to facilitate each discussion. Sometimes the group discussions focused on research articles teachers had been assigned to read. Other times, the coordinator would ask teachers to focus on pertinent topics, such as alternative forms of assessment. At the close of each day, teachers were expected to write a journal entry in which they reflected on the day's activities. In the evenings, the coordinator read the journals, and responded to them on the following morning in a group discussion.

The summer institute at this site was much more structured than the practicums, and ACOT teachers depended on having participating teachers in the classrooms for a specified time. Even though some teachers occasionally stated a preference for exploring the technology on their own during this time of the day, teachers were expected to be in their assigned classroom. During the remaining hours of the practicum, however, activities were somewhat more flexible.

### Site B Summer Institute

At Site B, the summer institute accommodated 28 teachers—four more than at the other two sites. Most of the teachers attending the summer institute at this site had previously attended a practicum. Also attending the summer institute were 40 students, most of whom were incoming ninth-graders who would be enrolled in the ACOT program in the fall. By attending during the summer, these high school students got a head start on technology training. They were also allowed to take home a computer for the rest of the summer. Other students were brought by the participating teachers, who encouraged their attendance in hopes that the students would be able to provide classroom assistance when school resumed.

At the summer institute at this site, the day was divided into three major components: the hour-and-a-half before students arrived was devoted to training, exploration, or discussion; two hours was spent working with students and project teachers; and after the students left, teachers had half an hour for reflection and sharing.

*At Site B, technology training was done via "mini-sessions." Representatives of each student/teacher group attended the mini-session and then returned to their groups to teach the other members.*

Rather than assigning students to specific ACOT classrooms, the entire group brainstormed topics and then small groups of students teamed up with participating teachers to work on particular projects. People who were interested in a specific topic, such as endangered animals, formed a team, and the teams varied in both size and student/teacher ratio. At this site, the curriculum had no overarching theme. Project topics ranged from the study of popular music using HyperCard to the creation of a tabloid using word processing.

Participating teachers came two days before the students. During this time, teachers learned basic skills on the Macintosh computer and how to use the network. Teachers were also introduced to ClarisWorks, a software program with word processing, graphics, spreadsheet, database, and communications capabilities.

Training on the technology continued throughout the institute through the use of "mini-sessions" on topics such as HyperCard, camcorders, laserdiscs, spreadsheets, scanners, CD-ROM drives, and telecommunications. There were also mini-sessions about troubleshooting specific equipment such as the printer, about grant writing, and about integrating technology into specific subject areas, including English, social studies, and science.

The mini-sessions were taught by the ACOT staff from Apple or the Teacher Development Center coordinator, and attendance at most of them was optional. Since most mini-sessions were scheduled at the same time that students were present, the coordinator recommended that a representative from each group go to the mini-session, learn how to use the equipment, and then teach the rest of the group. In this way, the work on the student/teacher projects would continue to progress. At times, mini-sessions overlapped, forcing teachers to make choices between a variety of topics. When there was enough interest, some mini-sessions were repeated.

Much of the communication that occurred between participants and the coordinator occurred electronically. Teachers received a daily agenda via e-mail and they were expected to send the coordinator a daily "journal" entry in which they reflected about the day's activities. Periodically, the coordinator would send each participant a list of technology skills that students and teachers should have mastered by that point in the Institute.

### Site C Summer Institute

The summer institute at Site C served 24 teachers, 12 of whom had previously attended a practicum. Thirty-six students enrolled in the summer institute from schools that had either worked with the ACOT project in the past or who had teachers attending in the summer. Student recruitment was difficult, according to the coordinator, because of the short duration of summer vacation in local schools. The students were enrolled in grades three through six.

*At Site C, students were in grades three through six. They worked in student/teacher groups on week-long projects that culminated in presentations. The group composition changed weekly, and the teams cycled through different learning labs.*

The summer institute at this site had a basic structure that was similar to that of the other sites: first, teachers spent about an hour meeting as a large group; then, for about three hours, the participating teachers worked with students; and finally, teachers came together again to share and reflect during the final hour of the day. Like their counterparts at the other sites, participating teachers at Site C had a few days before students arrived to learn specific hardware and software, and to meet with ACOT teachers.

Like their counterparts at Site B, participating teachers at this site worked on projects with teams of students. Project teachers served in an advisory capacity for both participating teachers and students instead of taking on the typical role of “teacher” for a group of students.

When students arrived at the institute, a team of participating teachers and students were assigned to a “learning lab” (an ACOT classroom). Each teacher/student team typically consisted of two teachers and two or three students. An ACOT teacher worked in each learning lab as a resource. Each teacher/student team had three days in which to create a presentation that had to do with the overall theme of “cycles.” Together, students and teachers planned their presentation, decided how they would integrate the available technology into the presentation, learned the technology, and made a presentation at the end of the week.

The coordinator deliberately grouped teachers who were from different schools. Each team also had students from various grade levels. When the teams moved into a different learning lab, they were asked to reorganize their groups. According to the coordinator, the reorganization was conducted because “teachers became too dependent on each other, and sometimes were too dependent on certain students.”

In each learning lab, ACOT teachers shared their particular areas of technological expertise with the teacher/student teams. For example, in one lab, the ACOT teacher taught HyperCard; in another, the technology focus was on the use of video. Although each lab had a specific technology focus, teachers and students were allowed to choose which technologies they wanted to incorporate into their presentation.

Rather than setting up participating teachers’ computers in a central location, as at Site A, the coordinator positioned them around the various classrooms. Teacher/student teams cycled through the rooms, accessing different stations. At the end of the institute, teachers were allowed to take home their equipment for the rest of the summer, with the understanding that the computer would be used in the classroom once school began.

At this site, teachers were at the summer institute two hours longer than students (one hour in the morning, and one hour in the afternoon). During these times, ACOT teachers met informally with the participating teachers, or participated in the practicum activities. These activities included guest speakers, presentations about specific hardware and software, and discussions about topics such as constructivism, alternative assessment, and grouping strategies.

*Findings indicate that the model of situated teacher development can be successfully implemented as designed. Participants' reactions were positive and most seem to be using what they have learned.*

*When participants first arrived in project classrooms, they were sometimes frustrated by the constructivist nature of the experience. Despite this initial reaction, however, most teachers adapted quickly and began enjoying the opportunities for exploration and discovery.*

## Results

While the ultimate goal of our research is to examine the impact of the program on participating teachers and their schools, it would be premature to draw conclusions about long-term program impact at this time. However, our findings for Year One indicate that the ACOT Teacher Development Center model of situated teacher development can be successfully implemented as designed. Participants' reactions to the program were positive and preliminary data that has been gathered for Year Two suggests that most participants are using what they have learned about technology integration and constructivist teaching in their classrooms.

Our experiences during the first year of the Teacher Development Centers project suggest that what we know to be true about creating successful learning environments for children is true for teachers, as well. Features that seemed most important in creating a learning environment where teachers can learn to integrate technology into their classroom included the following:

- The opportunity to explore; to engage in hands-on, active learning; to reflect; to collaborate with peers; and to work on authentic learning tasks—elements that characterize a constructivist learning environment
- The opportunity to work in real classrooms—to learn with and from students and accomplished teachers as they model technology integration and constructivist teaching strategies
- Assistance in applying what is learned during staff development to one's own classroom and school
- Immediate and ongoing follow-up support

## The Value of a Constructivist Learning Environment

As the above program description suggests, teachers at each center were given the opportunity to construct their own knowledge about specific technological tools as well as about technology integration in general. Although there was some didactic instruction on hardware and software, teachers were expected to “learn by doing” while the coordinator and project teachers served as facilitators.

Compared with a traditional classroom, a constructivist learning environment places more responsibility on students for their own learning. This type of responsibility can cause some children to feel frustrated and uncomfortable, particularly if they are accustomed to having a teacher who “transmits” information to them. However, with this added responsibility comes freedom—for individual exploration, for hands-on practice, and for reflection. Typically, once students overcome their initial discomfort, they begin to see the value of constructivist learning.

*Teachers appreciated both the time to explore and the time to think about and discuss the new information they were processing.*

From monitoring teachers' reactions to the program, we learned that adult learners are very much like their young counterparts in their attitudes toward constructivist learning. When teachers first arrived at the Teacher Development Centers they were overwhelmed—and sometimes frustrated—both by the sheer amount of technology and especially by the constructivist nature of the experience. Teachers came to the centers expecting the typical in-service experience—a highly structured, didactic training session, where a “trainer” dispenses information. Instead, they faced a loosely structured, learner-centered model with time to explore, experiment, and discover on their own.

Some teachers had a difficult time adjusting to this type of learning environment. Faced with the opportunity to learn a vast assortment of new skills in a relatively short period of time, many teachers at first believed that having a trainer “transmit” information to them would be the most efficient way of learning.

Despite this initial reaction, however, most teachers soon adapted to the center's learning environment. Within a few days, teachers who had originally begged the coordinators for more didactic instruction began enjoying the opportunities for exploration and discovery. For example, one teacher had the following “before” and “after” reactions:

**Before:** *I can see the value of learning on the job; yes, we do learn more thoroughly, but it is also much more painful. . . . This frustration does not lead me to want to discover more, but leads me directly to quitting and letting someone who does know what they are doing to do it. . . . I need more directions. . .*

**After:** *This is a fabulous experience and certainly well worth it, whether you are a novice or a “tried and true.” We “old timers” need these boosts to keep [teaching] fresh and exciting!*

Most teachers recognized and appreciated the differences between traditional in-service sessions and the Teacher Development Center. For example, one commented:

*This training is different. How? In every way—philosophy, structure, technology, and content.*

*Isn't it interesting that the activities that work with kids are just as powerful with adult learners? For such a long time, all in-services espoused cooperative learning, writing, discussion, etc., but they didn't model those strategies during the in-service. It's wonderful that we are finally getting beyond the telling and are into the showing and modeling when we talk about teacher training.*

The speed with which most teachers adapted to a constructivist learning environment can be illustrated by teachers' reactions to a three-day presentation on image processing conducted by trainers from a university. This workshop was held at all three sites. At two of the sites, the trainer utilized an approach that fit in well with the Teacher Development Center model; much of the training involved teachers and students working together in groups to explore the software and solve problems on their own, with the trainer serving as a facilitator. Teachers' reaction to the image processing workshop at these sites was overwhelmingly favorable.

*By working in real classrooms with real students, teachers are better able to see that what they are learning can be useful in their own classrooms.*

At the other site, a different trainer conducted the workshop, and his approach was completely didactic. Teachers sat through lectures for long periods of time, and did not have the opportunity to use the software with students. Teachers at this site were extremely negative about the image processing workshop, and made comments such as:

*An hour . . . is too long for a lecture. And I could feel the frustration, tension, exhaustion, and stress in the classroom.*

As one teacher explained, the presenter served as a “good negative role model” for “what not to do.”

### Time for Exploration and Active Learning

Like children, teachers want the opportunity for hands-on exploration. Although lecturing is the time-honored technique for covering the greatest amount of information, teachers, like students, quickly tire of being passive listeners.

At the center, teachers enjoyed the chance to “play” and explore with the technology. When teachers were asked to describe which aspects of the practicum they found the most helpful or rewarding, this type of response was common:

*To be honest, I was expecting to be extremely bored this week. All the in-services I have attended in the past have been informative yet not hands-on enough. Today has been wonderful. I feel like I have already doubled or tripled my knowledge of computers in one session because I actually got to touch and play with them.*

*The time we have for “hands on” in actual classrooms is the best way for us to learn. Just sitting and listening to somebody does not do it for me.*

### Time for Reflection

Another important aspect of a constructivist environment is the emphasis on the quality of understanding as opposed to the quantity. Learners are actively engaged in constructing their own knowledge and understanding rather than passively memorizing facts. In such an environment, learners are given time to reflect on what they are learning, rather than racing ahead in an effort to memorize even more information.

Although teachers were anxious to learn all they could during the one- or four-week period at the Teacher Development Centers, they quickly complained of overload if they were not given adequate time to think about the information they were processing. Attempts to rush through a set curriculum can often backfire with teachers, just as they can with students.

At the center, time for reflection—while participating in a group discussion or while writing a personal journal—was highly valued by teachers, as these quotes illustrate:

*Our reflection times have provided me the opportunity to share my fears, frustrations, questions, and excitement with others who understand where I am coming from.*

*I need to write about something to have it stay in my memory and I really do write to learn what I know and to organize things in my head.*

*The classroom observations not only provided participants with models of teaching strategies, new ideas, and validation for what they were already doing, they also stimulated discussions of educational issues.*

## The Value of Situated Staff Development

Learning is more meaningful when learners engage in activities that are directly related to their own needs. By working in real classrooms with real students, teachers are better able to see that what they are learning can be useful in their own classrooms. Staff development that is situated within the context of practice also allows participants to see accomplished ACOT teachers modeling a variety of teaching strategies—including the use of technology in project-based, interdisciplinary instruction. Observations gave some teachers new ideas for how they might integrate technology in their own classrooms. For teachers who saw ACOT teachers employing teaching strategies that they already used in their own classrooms, observations served as a source of validation. Observation also stimulated discussions about the philosophy of the program, and gave teachers the chance to see firsthand how technology can serve as a catalyst for change. We learned that opportunities to observe are most valuable when the coordinators act as guides and translators, through focusing the observations and using them as a basis for discussion.

### Classroom Observations

Because the Teacher Development Center consists of real teachers in real classrooms, visitors do not always see perfect lessons in which teachers are utilizing strikingly innovative teaching strategies. During the practicums, ACOT teachers did not change their planned instructional activities simply because they were being observed. At the center, observations were not staged “show and tell” activities, but real lessons with real students. Consequently, participating teachers occasionally saw activities such as direct instruction or a lecture. There were even some instances where students appeared off-task, or the teacher seemed to be “winging it.” Additionally, at each site, there were instances when ACOT teachers had to abandon their plans to utilize technology for various lessons when equipment would not work.

Some participants thought that technology was used virtually all the time in ACOT classrooms, when, in reality, a variety of instructional approaches are used, including traditional activities such as whole-class instruction mixed in with more constructivist, project-based teaching. Teachers were occasionally surprised when ACOT teachers had trouble with the equipment, thinking that they were “technology gurus” who could fix anything. Other teachers believed that the ACOT teachers “had to be leaving something out of the curriculum” after observing groups of students working on a HyperCard report.

*By observing technology use in a variety of different grade levels and subject areas—as well as for a variety of different instructional purposes—the participants saw what was possible.*

*Many of them also came away with a better understanding of how constructivist learning environments change students' and teachers' roles, and how technology can serve as a catalyst for this change.*

But whether the observed lesson was an exemplar of constructivism and technology integration or something completely different, observations such as these served as an important impetus for discussion between the participants. During the first day or two at the center, teachers were often reluctant to evaluate and question what they had observed in ACOT classrooms, or to discuss and reflect openly upon their personal beliefs about teaching. Rather, they preferred to talk about surface-level features of the ACOT classrooms, such as the hardware or software, as their focal point. As they spent more time at the center, however, a level of trust was built between participants and the coordinators that allowed more open discussion of topics such as teaching philosophies, alternative assessment, technology as an instructional tool, and shifting student and teacher roles. Most participants found the opportunity to discuss important educational issues with their colleagues invaluable, as these quotes illustrate:

*Having the time to talk with partners and colleagues is extremely important for support and validation. I certainly hope that our principal will allow my partner and me to have the opportunity to meet with each other and with others on the staff to plan.*

*The discussion is one of the most valuable times we spend. . . . It is great because it is practical, and we get to know each other better. As a new teacher. . . this is what I need. . .*

Although there were a few teachers who did not find classroom observations helpful, the vast majority of participating teachers felt that the opportunity to observe in ACOT classrooms was one of the most valuable aspects of their visit to the center. For teachers who were already utilizing strategies similar to those employed by ACOT teachers, the observations served as a source of validation, as this quote illustrates:

*I learned that using technology in the classroom is natural and effective and highly motivating—the end result for producing independent, self-directed learners. I'm pretty much at the same place in my instruction and philosophy.*

For some teachers, simply watching how the students used the equipment was eye-opening. One veteran teacher who had been using a computer in his class for years was surprised to find out that, "The project teachers let the children operate the computers . . ." Similarly, another teacher commented,

*I was using computers before, but as a result of my experiences at the center, I am now allowing my children to have more control of the equipment. Before, I would have the children type on the word processor, and I would save it for them. Then, in the evening, I would print their things for them. Now I let them do it all.*

Other teachers came away with specific ideas for integrating technology into instruction. For example, when asked what she had learned by observing in ACOT classes, one teacher commented that she had learned, "How to teach a computer lesson to a whole class. . . How to group children at computers." Another teacher stated:

*I was really impressed with the way Mrs. James handled all the activities in the room. I am interested in learning how to plan, implement, and manage stations. . . . It was so smooth in her classroom.*

*The work with students gave participants the opportunity to learn to facilitate as well as to find out firsthand, just how much students are capable of doing.*

By observing technology use in a variety of different grade levels and subject areas—as well as for a variety of different instructional purposes—teachers saw what was possible. Without this vision, teachers might return to their classrooms without making any instructional changes at all.

Since an important purpose of the Teacher Development Center was to introduce teachers to a constructivist model of instruction, it was encouraging to find that many teachers came away with a better understanding of how constructivist learning environments change students' and teachers' roles, and how technology can serve as a catalyst for this change. These quotes exemplify teachers' thoughts about this role shift:

*ACOT teachers are attending to at least four things at once. They are not standing in front of the classroom trying to get all thirty students to pay attention to them. They are guiding students individually. They are very flexible.*

*I saw a variety of teaching styles within the ACOT classrooms. All seemed to benefit by technology available to students. And in all styles student collaboration and tutoring seemed accelerated by technology. Teacher as "expert" is forced to diminish since none has knowledge about all technology.*

*Students can teach each other just as effectively, if not more so, as a teacher in the traditional role.*

### Working with Students

The participating teachers indicated that classroom observation enabled them to see what students were capable of doing with the technology. They noticed a high level of student collaboration and peer teaching during their observations, and they saw that project teachers often took the role of facilitator, while students frequently were called upon to play the role of expert.

Participants were a little anxious, however, about actually working with students during the summer institute, because they lacked confidence about their skill with the technology. They worried that they would not be able to "teach" the summer institute students, given their own inexperience with the new technological tools. We learned, however, that teachers' concerns quickly abated when they discovered that working with students gave them the opportunity to model problem-solving skills for the students, as well as to practice new skills with the technology. Teachers also discovered how much they could learn about the technology from the students themselves.

*With encouragement from the coordinators, most teachers gradually overcame their concerns about learning side-by-side with students. Moreover, they found that working with students reinforced their own burgeoning technology skills.*

#### Seeing students in a new light

Many teachers commented that it was useful for them to learn firsthand what students are capable of doing when given the chance. Teachers admitted that, before visiting the center, they often underestimated the capabilities of the students, as these quotes illustrate:

*It's really amazing how quickly the children learn. It must be just the adults who become intimidated by learning something new.*

*It upsets me to realize that we don't expect enough from the children. I look at what these children are capable of doing and it upsets me that I have expected so little from my students. I wish I had known this last year when I was teaching fourth grade. It is just such a waste when we don't give them credit for being able to do things for themselves.*

*I had already been into the discovery learning type of teaching, but I still thought that I had to sort of keep control and do things for the children, but I found out that they were really able to do much more for themselves than I gave them credit for.*

During the summer institutes, teachers also had the opportunity to work with children who came to the program with little or no background in technology. In doing so, teachers were able to see for themselves how quickly even young students can learn relatively complex software programs such as HyperCard. This experience gave teachers confidence that they, too, could teach their students how to use the technology, even when students were starting at "ground zero."

#### Learning to facilitate

During the summer institutes, teachers at each site were expected to work directly with students on various projects. In some cases, teachers were complete novices in using technology, and they worried because they did not know more than their students. In other instances, teachers were introduced to a technological tool only hours before being expected to teach students how to use it. In these cases, teachers voiced complaints such as this:

*I wish I had more time to spend playing with my computer before the students came so that I had a chance to try things before having to work with them.*

As the following quote shows, teachers not only had disliked giving up their role of expert, but had trouble relinquishing control as they tried to step into the role of facilitator:

*When working with students I also have difficulty keeping my hands off the mouse; however, I am making a conscious effort not to help students unless they ask and definitely not to touch the mouse.*

*To structure their observations and experiences, and to facilitate the transfer of new ideas into their own classrooms, the participating teachers were required to plan a project that they would implement upon returning to their schools.*

With encouragement from the coordinators, most teachers gradually overcame their concerns about learning side-by-side with students. Teachers often commented that the creation of student/teacher learning teams had distinct advantages over traditional modes of instruction. For example, while working in learning teams with students, teachers could model problem-solving skills, as these quotes illustrate:

*I enjoy learning and facilitating someone else's learning simultaneously. I think this is the ultimate way to teach because . . . teachers can develop the student's critical thinking by modeling, analyzing, and evaluating the problem-solving process as a team of learners. We are . . . participating as learners and teachers.*

*This experience has even made me take risks. I've decided the worst that can happen is I make mistakes and I need to ask others for help. I think if I show that I take risks and make mistakes in teaching my children will feel more comfortable doing the same in learning.*

Moreover, teachers found that working with students reinforced their own burgeoning technology skills. Instead of having to wait until they returned to their own classrooms in the fall, teachers could try out their newfound skills immediately, as these quotes show:

*I taught a small group of second-graders HyperCard right after I learned the program. This was super, since it really made the program sink in for me. . . [This was] a great experience for me since I got to instantly use the information I was learning with students, so I got to practice how to teach these great things.*

*I missed being in the ACOT classroom with the students today. I feel that's where I really learn the most. It gives me a chance to practice what I have learned and by helping the students, it reinforces the concepts that I am unsure of.*

## The Value of Having Specific Plans for Change

To structure their observations and experiences, and facilitate the transfer of new ideas into their own classrooms, teachers were asked to plan an actual project that they would implement upon returning to their schools. At each site, both practicum and summer institute teachers were required to write a formal proposal about how they would integrate technology into their instruction. Coordinators (and sometimes ACOT teachers) worked closely with the teachers to brainstorm ideas for the projects and to give guidance.

*The teacher development program includes a two-part follow-up component. The project coordinators visit the participants' classrooms, provide frequent feedback about the implementation of their projects, and encourage an ongoing conversation about instructional change. The coordinators also provide support in everything from discussing school technology goals with the principal to helping to set up hardware.*

Teachers' plans varied tremendously in scope and focus. Some teachers planned small lessons, while others planned month long interdisciplinary, project-based units. Some teachers worked alone, while others worked in teams that crossed interdisciplinary, grade level, and school lines. The following descriptions illustrate the types of projects teachers created:

- An elementary teacher planned a six-week unit called "Holidays Around the World," which integrates reading, language arts, social studies, science, and art. In this unit, students research and write a report on the country of their heritage, including information about the country's geography, climate, life-forms, and culture. Students use HyperCard and a scanner to create the report, which is presented to the class using a television monitor or LCD display. On the last day of the unit, students prepare a dish for the class that is traditional to a holiday of their country.
- Two middle school teachers planned a short unit that was related to the areas of language arts and health. In health class, students brainstorm ideas about peer pressure. During language arts class, students work either individually or in groups to write plays or stories on the computer about a topic relating to peer pressure. Students present their work to their peers in the school auditorium.
- In an elementary classroom, students use a software program that enables them to learn about weather. While working with the program, students learn how air pressure, wind speed and direction, humidity, and temperature can be used to predict weather. Students then prepare their own forecasts based on data given to them by the software program.

While teachers were encouraged to be ambitious and creative, they were also urged to be realistic and to take into account the constraints of their settings, such as curricular mandates, lack of time, or lack of equipment. The major purpose of the project was to get teachers to utilize the resources they already had on hand to take the first step toward technology integration and constructivist teaching. Through the process of planning their projects, even teachers with a minimal amount of technology realized that they did not have to have the same resources as project teachers in order to make positive changes in their classrooms. As one teacher stated, "I learned that one computer can be an effective teaching tool in the classroom."

### The Value of Immediate and Ongoing Follow-up Support

New skills need to be reinforced. Teachers, like students, cannot be expected to engage in new skills or behaviors without getting feedback and support soon after they are introduced to the new activity. We found that teachers' excitement and enthusiasm about integrating technology often faded when they were not given support within a few weeks of attending the staff development program.

*Lessons that had been learned about teacher development during the first six years of ACOT—and from three years of piloting the Teacher Development Center program—were built into the program and contributed to the successful first year. One example is the requirement that teachers attend in teams of at least two from a school; another is the requirement that principals commit to specific conditions that facilitate a changing vision of learning and instruction.*

Although teachers attending traditional in-services generally want to implement the new skills they have learned, their plans are often sabotaged by the everyday realities of classroom life. Few teachers have the time, energy, or resources to make major changes in their classrooms without the ongoing support of their colleagues and administrators. A crucial part of the program is the ongoing support from the Teacher Development Center coordinators. This support can take a variety of forms, from helping to set up hardware to discussing school technology goals with the principal. We learned that teachers need, and want, immediate ongoing support once they return to their classrooms.

From the outset, teachers visiting the center wondered if they would have the support they needed to make changes in their classrooms. As one coordinator noted:

*Teachers wanted some assurances that they weren't going to lose me [the coordinator] and they wanted to know what kind of support the district office was giving them.*

Indeed, coordinators found that immediate and ongoing support was crucial for participating teachers as they began to implement what they had learned at the center. Teachers left the center excited and anxious to get started, but often went back into classrooms and had difficulties setting up or using the equipment. Coordinators found that the initial excitement was sometimes lost if teachers could not obtain the help that they needed, as these quotes from coordinators' journals illustrate:

*It's really important to get into the participating teachers' classrooms as quickly as possible after they visit the center to work with the teachers and give them that extra support. They leave the program . . . really jazzed about working on some aspect of technology and now all of a sudden something doesn't work or it doesn't seem to fit quite right and they need that extra support and if they don't get it, they get discouraged. Also, if you can't get back to them right away, they tend to just leave everything and forget about it.*

*I made my first follow-up to the elementary school. And what I found when I arrived at the school was that the teachers had just received their computer and printer in their room the day before. . . . The teachers said the administration was trying to break their necks to get the computers in before I arrived. And so it points out again how important it is for me to make that first visit within the next week after their visit to the center, because if they don't have the equipment to start their proposals and I don't show up for a month, nothing is going to happen. But if they know I'm coming, the administration really tries to get the technology there so they can get started.*

*The largest barriers to program implementation during the first year of the project included problems with communication, with clearly defining roles and responsibilities of project staff, and with team building.*

*In many cases, the barriers were interconnected, making obstacles even more difficult to overcome. When financial concerns were added, the problems sometimes seemed insurmountable.*

In addition to getting assistance from the coordinator, teachers turned to each other for help with troubleshooting equipment, to share ideas for lessons, and for emotional support. This type of camaraderie was not limited to teams of teachers from within a particular school, but included “Teacher Development Center graduates” from schools throughout each district. Informal teacher networks have been developed at each site; some teachers communicate by phone, while others use telecommunications. Still others meet on a monthly basis to share success stories, demonstrate new skills, and receive additional training. For some teachers, participation in the Teacher Development Center has served to whet their appetite for new learning, and they are not shy about asking for—or demanding—additional support, as this quote from a coordinator’s journal illustrates:

*I’m also going to start weekly meetings with the center teachers at our school. . . . They want extra training and they want to look at this or want to try that or they want to exchange ideas. . . . I know, according to the grant, there’s only supposed to be like two follow-ups, but . . . these people being in the school have some expectations of more contact, more support. . . .*

## Supports for Program Implementation

### Teacher Teams

First-year project implementation went more smoothly than many programs in the start-up phase, primarily because lessons that had been learned about teacher development during the first six years of ACOT—and from three years of piloting the Teacher Development Center program—were built into the program from the outset. For example, to increase the likelihood that teachers would have some support for change when they returned to their schools, the program required that teachers attend in teams of at least two from each school. Although a few principals asked to send individual teachers from their schools rather than a team, they were not accommodated. Since the coordinator cannot always be available to answer participants’ phone calls or make site visits, having a colleague on hand who can provide technical, instructional, and emotional support can make the difference between computer equipment sitting idly and successful technology integration. We found that, in many cases, teachers who had come to the centers in teams continued working together upon returning to their school, giving each other vital support.

*By the end of the first year of the project, many of these problems were well on their way to being solved. Individual responsibilities have been more clearly defined, arguments about control and power have subsided, and communication has improved. Substantial progress has been made in the area of team building.*

## The School Site Principal

Previous experience in staff development also suggested to program designers that principals' commitment to a changing vision of learning and instruction is critically important to the success of a staff development program. Therefore, principals had to commit to the following conditions in order for their teachers to participate at the centers:

- Release teachers from their regular classrooms to visit the Teacher Development Center
- Provide teachers with access to a computer, printer, and software immediately upon their return to the school
- Provide teachers with the authority and flexibility to adjust daily instructional schedules and to develop curriculum objectives that promote team teaching and interdisciplinary instruction
- Allow time each day for teachers to meet and plan
- Provide time for teachers to reflect on their practice
- Acknowledge the importance of their teachers' efforts to the rest of the staff

## Barriers to Program Implementation

At each site, issues arose that hampered program development to some degree. The largest barriers to program implementation during the first year of the Teacher Development Centers project included problems with communication, with clearly defining roles and responsibilities of project staff, and with team building. In many cases, these barriers were interconnected, making obstacles even more difficult to overcome. And, when financial concerns were added to the equation, the problems sometimes seemed insurmountable.

For example, at one site, there were changes in personnel at the district office in the fall. Longtime advocates of the ACOT project were shifted into different positions, and new people came into positions of power who had little or no knowledge of the program. This led to some confusion about the Teacher Development Center coordinator's role and her responsibilities. At times, she was unexpectedly assigned to participate in schoolwide activities that added responsibilities to an already full schedule. In other instances, she was expected to get approval from administrators to do tasks that she had done, on her own, for years. The coordinator became extremely frustrated in her efforts to clarify her role, and to explain the project, to busy administrators. Fortunately, as the new administrators became more knowledgeable about the project, the problems related to lack of communication subsided.

At another site, problems emerged that were similarly related to miscommunication and control of limited resources. When the coordinator came to the center she found she had no phone, no desk, and no office supplies. There was also no consensus between the school and the district about who was supposed to provide this equipment. Eventually, the supplies and a desk were purchased and a phone was installed. Unfortunately, the haggling that occurred about who would purchase the supplies made the coordinator feel like an unwelcome outsider at the school.

*In order to fully exploit the power of technology, teachers must be provided with adequate training and support. Unfortunately, current training programs do little but preserve the instructional status quo.*

Although issues related to office supplies seem trivial on the surface, the incidents that occurred at this site once again point to a bigger issues—issues related to power, control, and communication. Funds had been donated to each site from Apple Computer to support the center and the regular ACOT teachers. There was confusion, however, about who was responsible for buying supplies for the center, who was in control of the money that Apple had donated, and what types of purchases should be made with these funds. In hindsight, these problems could have been avoided if time had been taken to clarify participants' roles and responsibilities. The importance of ongoing, open communication between project staff, school-site administrators, and district personnel cannot be overemphasized.

Successful implementation also depended in part on creating a viable team at each site. According to the design of the project, the Teacher Development Center coordinator, the ACOT coordinator, and the ACOT teachers had important roles to play in project implementation: the Teacher Development Center coordinator was responsible for overseeing project implementation; the ACOT coordinator was responsible for providing instructional and technical support for the ACOT teachers; and the ACOT teachers were responsible for working with the participating teachers and serving as peer coaches. Since the project model was flexible in design to allow each site to develop its own program, the team's abilities to work together, to cooperate with one another, and to make important decisions about program implementation, are particularly important.

Unfortunately, miscommunication, power struggles, and ambiguously defined responsibilities of project staff took their toll on efforts to create a shared vision for the project at each site. During the first year, there was confusion about who was "in charge" and who was responsible for what tasks. At each site, there were power struggles—sometimes between the project coordinator and the ACOT coordinator; other times between the project coordinator and school site administration; occasionally between school and district administrators; and even between ACOT teachers. At one site, the project coordinator was new to the ACOT project, and team building was made even more difficult by the fact that she was viewed by the ACOT teachers as an "outsider" since she was new to the school site.

By the end of the first year, many of these problems were well on their way to being solved, primarily because of the hard work of ACOT staff from Apple, Teacher Development Center coordinators, ACOT teachers, and steering committee members and their sheer determination to make this project succeed. Individual responsibilities have been more clearly defined, arguments about control and power have subsided, and communication has improved. The Teacher Development Center project is now well into its second year, and though there will, no doubt, be new barriers to program implementation, substantial progress has been made in the area of team building.

*The model created by the ACOT Teacher Development Centers project suggests that principles of instruction that are successful for young learners also apply to adults. Perhaps most important, the program provided the opportunity for teachers to work in real classrooms, and to see models of constructivist teaching firsthand.*

*The data suggest that this model of professional development has had a positive impact on many participants. They return to their classrooms with the belief that they can—and will—make positive changes in their classrooms and schools.*

## Conclusions and Implications

Numerous studies have found that the introduction of technology can lead to important changes in teachers' method of instruction. For example, in a study on the potential of interactive learning tools for improving the quality of education, the Office of Technology Assessment (OTA, 1988) reported:

*One of the most significant impacts of the use of computers in the classroom is change in teaching style. Teachers can go beyond the traditional information delivery mode where they are presenters of ready-made knowledge and become facilitators of students' learning. (p. 91)*

Other studies have shown that technology can also have a positive influence on student engagement (Sandholtz, Ringstaff & Dwyer, 1992); on higher-order thinking skills (Tierney, Kieffer, Stowell, Desai, Whalin & Moss, 1992); on student empowerment (Fisher, 1989), and on other student outcomes.

In order to fully exploit the power of technology, however, teachers must be provided with adequate training and support. Unfortunately, OTA's (1988) national study suggests that only one-third of all K–12 teachers have had as much as 10 hours of computer training. And, even if a greater amount of time were spent on technology training, current methods of professional development are woefully inadequate, because most focus on learning about computers rather than on learning how to integrate computers into the curriculum. As such, these training programs do little but preserve the instructional status quo. According to Lewis (1994), teachers condemn this type of staff development. Instead, Lewis reports, teachers want “challenging experiences and opportunities to collaborate seriously with their peers who have good ideas and are excited about what they are doing.”

Clearly, new forms of professional development need to be created that show teachers how to use technology to its fullest potential as a tool for constructivist learning. The model created by the ACOT Teacher Development Centers project suggests that principles of instruction that are successful for young learners also apply to adults. The teachers who participated in the program benefited from the opportunity for hands-on, active learning; for working with colleagues; for reflection; and for creating projects that could be used in their own classrooms. Perhaps most important, the teacher development program created by ACOT provided the opportunity for teachers to work in real classrooms, and to see models of constructivist teaching firsthand.

Although we are still in the process of collecting data on the Teacher Development Center project's long-term teacher impact, a preliminary analysis of data gathered during the second year suggests that this model of professional development has had a positive impact on many participants. Teachers are indeed beginning to integrate technology into their own classrooms, and in many cases are moving toward a more constructivist approach to teaching. There are numerous reports of participating teachers who are sharing their knowledge and expertise with other members of their staff, and of those who are applying for and receiving grants for more technology for their schools. Perhaps most important, when they leave the centers, many participants feel a greater sense of professional efficacy; they return to their classrooms with the belief that they can—and will—make positive changes in their classrooms and schools.

## References

- Brown, A. & Campione, J.** (1990). *Communities of learning and thinking, or a context by any other name*. Berkeley, CA: Education in Mathematics, Science, and Technology, School of Education, University of California, Berkeley.
- Carnegie Forum on Education and the Economy.** (1986). *A nation prepared: Teachers for the 21st century*. NY, NY: Carnegie Corporation of New York.
- Collins, A.** (September, 1991). The role of computer technology in restructuring schools. *Phi Delta Kappan*, 73(1), 28–36.
- Dwyer, D., Ringstaff, C. & Sandholtz, J.** (1991). Changes in teachers' beliefs and practices in technology-rich classrooms. *Educational Leadership*, 48(8), 45–54.
- Fisher, C.** (1989). The influence of high computer access on student empowerment: An exploratory study of the Nashville ACOT site. Unpublished manuscript.
- Holmes Group.** (1990). *Tomorrow's schools: Principles for the design of professional development schools*. East Lansing, MI: The Holmes Group, Inc.
- Lewis, A.** (March, 1994). Developing good staff development. *Phi Delta Kappan*, 75(7), 508–509.
- Ringstaff C., Sandholtz J. & Dwyer, D.** (in progress). Trading places: When teachers utilize student expertise in technology-intensive classrooms. *People and Education*.
- Ringstaff, C., Stearns, M., Hanson, S. & Schneider, S.** (1993). *The Cupertino-Fremont Model Technology Schools Project: Final Report*. California: SRI International.
- Sandholtz, J., Ringstaff, C. & Dwyer, D.** (1992). *Student engagement revisited: Views from technology-intensive classrooms*. Paper presented at the annual meeting of the American Educational Research Association, San Francisco.
- Schofield, J. & Verban, D. (1988).** Computer usage in teaching mathematics: Issues which need answers. In D. Grouws and T. Cooney (eds.), *Effective Mathematics Teaching*, vol. 1 (pp. 169–93). Hillsdale, NJ: Erlbaum.
- Sheingold, K.** (September, 1991). Restructuring for learning with technology: The potential for synergy. *Phi Delta Kappan*, 73(1), 17–27.
- Tierney, R., Kieffer, R., Whalin, K., Desai, L. & Moss, A.** (1992). *Computer acquisition: A longitudinal study of the influence of high computer access on students' thinking, learning, and interactions*. Columbus, OH: ACOT Longitudinal Study, The Ohio State University.
- U.S. Congress, Office of Technology Assessment.** (1988). *Power On! New Tools for Teaching and Learning*. Washington, D.C.: U.S. Government Printing Office.

APPLE CLASSROOMS OF TOMORROW

**Apple Computer, Inc.**

1 Infinite Loop  
Cupertino, CA 95014

Phone: 408-862-5134

Fax: 408-862-6430

[acot@applelink.apple.com](mailto:acot@applelink.apple.com)

L00804A