



APPLE CLASSROOMS OF TOMORROW

**Teaching in
High-Tech Environments:
Classroom Management
Revisited
First-Fourth Year Findings**

Authors

Judith Haymore
Sandholtz, Ph.D.
Cathy Ringstaff, Ph.D.
David C. Dwyer, Ph.D.
Apple Computer, Inc.

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Research

Apple Classrooms of Tomorrow (ACOT)SM 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.

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Most teachers who joined the ACOT project had years of classroom experience, but when multiple computers entered their classrooms, they felt like novices again. Teachers did not anticipate the range of student misbehaviors, the technical problems, or the shift in their teaching roles.

Consequently, these veteran teachers revisited the same three stages of development they experienced as beginning teachers: survival, mastery, and impact.

At first, they focused on controlling student behavior and classroom procedures, including handling unfamiliar equipment. Gradually, as they gained confidence, they solved these problems and began to focus on students' achievement and attitude.

Introduction

Since 1985, the Apple Classrooms of Tomorrow (ACOT)SM research project has provided teachers and students at five public school sites with individual computers for use at school and at home. Consequently, these teachers have spent more time teaching in high-tech classrooms than any other teachers in the world.

Although most ACOT teachers taught for years before entering the project, the introduction of computers into their classrooms significantly altered their teaching environments. In many ways, they felt like novices again. None anticipated the range of student misbehavior, changes in the physical environment, shift in their teaching roles, and technical problems that would accompany the new technology. Nor did they anticipate how quickly they would learn to utilize the technology to their advantage in managing the classroom in areas such as grading, individualizing instruction, developing materials, and increasing motivation.

While preservice teacher education typically includes training in classroom management techniques, little is known about classroom management in high-access-to-technology environments. The existing research offers few suggestions to practitioners entering classrooms filled with computers, networks, laserdiscs, printers, and other technological tools. Instead, the reports make recommendations related to computer laboratories or classrooms with one or two computers (e.g., Amarel, 1983; Ragsdale, 1983; Hoffman, 1984).

Researchers studying teacher development have found that beginning teachers progress through a series of stages: survival, mastery, and impact (Fuller, 1969; Hall & Loucks, 1979). When first entering the classroom, teachers focus on themselves, concentrating on issues such as controlling student behavior. As they gain self confidence, they become better able to anticipate and solve problems, and gradually the focus shifts to their impact on students' achievement and attitude. This three-stage model can also be used to understand the development of experienced teachers who are implementing educational innovations, and data from this study support the assumption that experienced teachers entering high-access-to-technology classrooms also move through these stages.

This report describes how teachers in the ACOT program progressed from frustration to success in coping with changes brought about by the introduction of computers into their classrooms.

This four-year study examines ACOT teachers at five public school sites from 1986–89. The schools reflect the nation's diverse populations and conditions; the ACOT classrooms within these schools provide teachers and students with immediate access to interactive technologies.

This report focuses on the evolution of classroom management in high-tech classrooms. Data analysis suggests a three-stage model of development: survival, mastery, and impact.

Because teachers are focused on controlling the classroom in the early stages, little attention is given to new instructional approaches. Instructional development begins when teachers have mastered management issues.

The Study

Overview

Context

This qualitative study examines classroom management data from 32 elementary and secondary ACOT teachers in five ACOT school sites located across the country. These sites reflect the diverse populations and conditions found in contemporary public schooling. Each site began with one classroom in the fall of 1986, adding classrooms, staff, and students in subsequent years. By the spring of 1989, the five sites included grades 1–6 and 9–12, located in communities that ranged from low SES urban, to high SES suburban and middle SES rural areas.

In each of these settings, students and teachers have constant access to interactive technologies, including Apple®II and Macintosh® computers, printers, scanners, laserdisc and videotape players, modems, CD-ROM drives, and hundreds of software titles. Technology is used as a tool to support learning across the curriculum and the classrooms serve as multimedia environments where students and teachers use textbooks, manipulatives, crayons, overhead projectors, televisions, pianos, etc., as well as computers. The operating principle is to use the media that best supports the learning goal.

Focus and Conceptual Framework

The focus of this study is on the evolution of classroom management in ACOT's high-tech classrooms. Analysis of data in this area suggests a three-stage model of development that reflects teacher concerns about classroom management: survival, mastery, and impact.

In the survival stage, teachers are preoccupied with their own adequacy. Their concerns center on their ability to control the class and they spend considerable time reacting to problems instead of anticipating and avoiding them. In the mastery stage, they begin to anticipate problems and develop strategies for solving them. Finally, in the impact stage, teachers focus on the effects of their teaching on students' achievement and attitudes, and begin to use the technology to their advantage.

Evidence of moving from stage to stage is not always clear cut, however, as individuals may vacillate between phases. For instance, in this study, by the second year, most teachers had learned to expect occasional technological problems, such as disk failures or network bombs, and planned accordingly. Yet, when new software, hardware, or students arrived on the scene, many teachers temporarily reverted back to the survival stage.

Relationship Between Classroom Management and Instruction

This report examines classroom management rather than instruction. However, these two aspects of a teacher's job are so related that it is important to consider what occurs instructionally while teachers struggle with classroom management issues.

Data sources include weekly written reports, correspondence, and bi-monthly audiotape journals in which teachers reflect on their experiences.

Instructional innovation begins to emerge when teachers have achieved a significant level of mastery over management issues.

Because the sheer number of computers in ACOT classrooms radically transformed both the physical environment and classroom management, instruction remained relatively unchanged in the early years of the project. Another study that examined ACOT teachers' instructional development (Dwyer, Ringstaff, & Sandholtz, 1990) identified five stages of evolutionary change: Entry, Adoption, Adaptation, Appropriation, and Invention. The study revealed that teachers first used technology to strengthen the traditional text-based curriculum delivered in a lecture-recitation-seatwork mode. Later, as teachers became more confident with technology, they invented more dynamic learning experiences for the students. (For a more complete explanation of this research on instructional development, see ACOT Reports #8 and 9.)

In comparison to the slow pace of instructional change, dramatic shifts in classroom management were required immediately to establish order in these radically different teaching environments. As the diagram on page 7 illustrates, teachers moved through the classroom management stages of survival, mastery, and impact more quickly than through the instructional stages. Consistent with other research in classroom management, this study showed that instructional innovation is not likely to occur until teachers have achieved a significant level of mastery over management issues.

Data Collection and Analysis

This longitudinal study involves analysis of data collected during a four-year period, from October 1985 through June 1989. Data sources include weekly written reports sent via electronic mail, correspondence between sites, and bi-monthly audiotape journals in which teachers reflect on their classroom experiences.

The research team transcribed all written communications and summarized the audiotapes. To facilitate analysis, the narratives were divided into episodes with each episode representing an event with a beginning, middle, and end. Episodes were indexed for retrieval using a variety of categories and subcategories (e.g., participant, affective tone, context, general theme).

The complete database includes over 13,000 episodes. A relational database is used to manage and analyze the data. This software allows data to be organized in a multitude of ways (e.g., by teacher, by school site, by thematic categories). For this report, data were organized longitudinally to examine changes in teachers' classroom management concerns over time. The analysis provides a view of the teachers' "collective consciousness," documenting general trends related to classroom management concerns during the evolution of the project.

The introduction of computers to classrooms opened up a whole new realm of student misbehaviors. These included copying software illegally, stealing work from others' disks, tampering with the network system, resisting transitions to non-computer activities, and more.

Technology also created physical problems in the classrooms. Window glare, chalk dust, and power outages contributed to teachers' frustration, as well as setting up equipment, rearranging it, and simply working around all the hardware and software.

Technical problems were the most frequent complaints made by teachers. Computer breakdowns and network jams, software incompatibilities and distribution hassles caused many teacher headaches. Since instruction often depended upon the technology, problems upset both daily and long-range plans.

Classroom dynamics created additional problems. Many teachers were bothered by the increased noise and movement that emerged in their high-tech classrooms. Some felt threatened by the students' technology expertise and their new power to learn independently with technology.

The Findings

Stage One: Survival

There are so many [technical problems] like this that we deal with on a day to day basis that I didn't anticipate being part of this program. I'm anxious for the weekend so I don't have to do anything with computers.

An important concern of teachers in the survival stage was their inability to anticipate problems. Data analysis revealed a number of common problems that fell into four categories: student misbehavior and attitudes, physical environment, technical problems, and classroom dynamics.

Student Misbehavior and Attitudes

The introduction of computers to classrooms opened up a whole new realm of student misbehaviors. As students learned to use the technology, some also discovered how to copy software illegally, protect their disks from teacher access, and sabotage other students' work.

New methods for cheating also accompanied the new technology. Knowing that the teacher could no longer rely on handwriting to distinguish an individual's work, some students stole other people's disks or copied work from the disks before returning them. Other students used more advanced techniques for cheating, such as figuring out how to get 100% on a computerized test without doing any of the work.

In many cases of student misbehavior, the actions stemmed from the children's inquisitive nature. On one occasion, some students experimented with a magnet to see "if it really does erase a disk." "It did," reported the disgruntled teacher. While the teachers admired the students' curiosity, they decried the results of the students' misguided adventures. One of the most frustrating situations was when students caused problems with the computer network system because it shut down all the computers in the classroom.

Teachers also found themselves unable, in the beginning, to deal with student attitudes. Students became so enamored with the computers that they were unwilling to work with paper and pencil. Several of the software programs intrigued them to the point they resisted when teachers decided to move on to other activities. In addition, the use of home computers provided students a host of new excuses for not completing their homework. Hardware problems on the home computer became the most typical excuse. One teacher, after finally catching on to the scheme, started keeping a record of all the excuses given by students.

Physical Environment

The addition of computers to the classroom also created a number of problems related to the physical environment. For instance, the classroom lighting and the glare from windows made it difficult to view images on the computer and large screen monitors. Chalk dust fell into the equipment and caused problems. Power outages created major disruptions and so did extreme weather conditions. Hot weather caused computers to crash in schools without air conditioning, and rainstorms flooded several classrooms, damaging equipment and making it dangerous to turn on the computers.

Teachers also expressed frustration at having to spend extra time setting up equipment. Besides the initial set-up, teachers dismantled computers for repairs and rearranged them for special projects and various other reasons. In addition, teachers who were accustomed to neat and orderly classrooms became bothered by the clutter created by so much hardware and software. Classrooms had become much more crowded, making it difficult to move around and work with individuals, or to facilitate spontaneous group work.

Technical Problems

Most teachers do not have to worry about technical problems on a day-to-day basis, but ACOT teachers constantly face technical problems because of the amount of equipment they deal with routinely. And since their instruction is computer-centered, technical problems upset both their daily and long-range plans. During the four-year period of this study, the most frequent complaints lodged by teachers related to technical problems.

Hardware problems ranged from equipment failing to arrive on time at the beginning of the school year, to continual breakdowns throughout the year, and slowdowns when printers backed up and networks jammed at the end of a period. Without functioning equipment, the curriculum got bogged down and students fell behind in their work.

Bringing computers into the classrooms meant that teachers had to deal with software and all of its accompanying headaches. Perhaps the most frustrating problems resulted from some incompatibility between the software and the computers or printers. In addition, software often arrived late and without enough classroom copies. At several sites, the local suppliers were unable to keep enough disks in stock to meet the demands of the ACOT classrooms. Some teachers became overwhelmed by the sheer number of disks and programs they had to manage daily.

Classroom Dynamics

Another concern of the first stage centered on teachers' abilities to understand the dynamics of the classroom environment. Many teachers initially were troubled by the increase in noise level and the necessity for students to move freely around the classroom. Having become accustomed to students sitting in their seats and the teacher in front of the classroom, some teachers worried whether the students were on task and learning.

In many cases, teachers found themselves faced with knowing less than their students about hardware or software, upsetting their traditional views about teacher role. While some felt threatened by that situation, others described it as exciting and were inspired to increase their own knowledge.

Since computers facilitated independent learning, some teachers felt that they were no longer teaching and suggested that the classrooms had become "technology centered, not instruction centered." They wondered if they were accomplishing their main goal of "teaching students the content."

In the mastery stage, teachers had developed strategies for dealing with many of the problems. They treated misbehavior with appropriate consequences and cheating with class discussions and grading penalties.

They designed new physical arrangements to optimize classroom space and organizational systems for software and other paraphernalia. they also recruited students to help set up and arrange equipment.

Technical problems continued, but were less disruptive, and teachers were more able to avoid problems or at least identify them when they occurred.

Teachers developed expertise with the technology, resulting in greater confidence and increased tolerance of noise and movement. Students' engagement increased and discipline problems decreased.

Stage Two: Mastery

We really feel we're off to a smooth start this year. We took a week of planning time before school began to get ready and that really helped. All the rooms are up and running. . . .

In this stage, teachers began not only to anticipate problems but also to develop strategies for solving them. To deal with student misbehavior, for instance, teachers designed consequences for those behaviors, such as removing computer privileges. To deal with cheating, teachers adopted strategies such as confronting offenders individually, holding class discussions on ethics, and imposing grading penalties. Some teachers figured out how to use the technology to catch the offenders and stifle recurrences. For example, one teacher merged students' individual databases and resorted the data, revealing that several students had copied incorrect data from one another.

In dealing with problems related to the physical environment, teachers arranged the classrooms to allow for the greatest amount of free space and developed systems for organizing software, printer paper, and other paraphernalia. They also wrote proposals for glare-proof windows, static-free carpeting, and dustless white boards.

To counteract the amount of time spent setting up and arranging equipment, some teachers began to enlist student help, figuring it would help them learn to set up their home computers as well. One site scheduled a full week of planning time before school started to set up the classrooms.

Technical problems continued throughout the four years of this study. Given the number of computers and the frequency of use, malfunctioning equipment became a fact of life in the ACOT classrooms. Consequently, teachers developed alternate lesson plans for times when the computers were down. They also devised rules for printing and network use to avoid jamming the systems at the end of the period. With experience, teachers became better able to avoid problems or at least pinpoint the source of problems when they did occur. One teacher, after completing computer repair training, was delighted to discover that he could solve problems that puzzled even the district technician.

Teachers worked hard to increase their own expertise with the technology. They spent time in the summer learning new software, attended one another's classes, and found numerous ways to share newly acquired skills. Their increased knowledge in turn strengthened their instruction as well as their classroom management. Teachers began to envision long-term instructional goals that focused on successful problem solving and conceptual understanding rather than specific content.

Increased teacher knowledge also had a noticeable impact on student engagement, lessening discipline problems that had plagued teachers at the beginning. By the second year of the project, reports of increased student engagement and motivation were common. Teachers also began to accept the need for students to move freely around the classroom and became less bothered by the noise level.

When teachers reached the impact stage, they used technology to help manage the classroom. They used it to keep records, grade tests, develop materials, and individualize instruction.

Teachers devised ways to cover the standard curriculum faster with computers, leaving time for problem solving and higher-level thinking.

They began to employ student experts as peer teachers, and generally their teaching approach shifted from instruction-centered to learner-centered. This shift resulted in greater student interest and motivation, causing students to be more confident and competent learners.

Stage Three: Impact

It would be hard to live without a computer. . . . It has become a way of life.

In the impact stage, teachers used technology to their advantage in managing the classroom. Rather than just troubleshooting, teachers developed techniques for monitoring student work, keeping records, grading tests, developing materials, and individualizing instruction. As they learned more about computers and software, teachers discovered the technology could save time rather than create additional demands.

One of the first areas where teachers learned to utilize technology to their advantage was recordkeeping. By creating databases and spreadsheets on the computer, they significantly decreased the amount of time they spent keeping track of everything from teaching materials to grades. Some teachers used commercial programs for calculating grades while others developed their own. One site developed a form for preparing the Individual Education Plan (IEP) required for special education students. After the teachers started using databases and spreadsheets for such recordkeeping tasks, they began discovering more and more useful applications.

As the teachers began exploring software more aggressively and sharing ideas more freely, they came up with improved techniques for developing assignments and tests, such as placing them directly on the network rather than running off separate assignment sheets. They discouraged cheating by producing three or four different forms of a test. They updated tests and materials periodically, and they individualized assignments. Teachers also began to craft new ways to optimize the computer's ability to provide immediate feedback. One teacher, for example, designed an algebra activity that involved students in entering values for variables and receiving instant feedback messages. Clearly, teachers were beginning to use the computer to their own advantage.

As they became more familiar with computer applications, teachers developed strategies for increasing the amount of material they could cover during the school day. Math teachers reported they could reduce class time spent on practicing arithmetic skills by relying on computer homework; this freed class time for developing problem-solving skills. A science teacher, who formerly spent ten complete class periods on a biology lesson about DNA modeling, used the computer to design a lesson with graphics that required only 40 minutes of class time. With less class time spent on standard topics, they could enrich the curriculum and revise their focus of instruction. (Note how this correlates to the adaptation phase in the diagram on page 7.)

As teachers became less threatened by some students' exceptional abilities on the computer, they reframed their views about teacher role and employed these experts as peer teachers. This made it possible to provide more individual help to those who were experiencing difficulties. One teacher developed an assignment that required students to not only solve a problem but also to design a system for helping other students with the problem. Some teachers also began to draw upon students' expertise when problems occurred that the adults could not solve.

When large numbers of computers entered their classrooms, even experienced teachers felt like novices again. Organizing the physical environment, controlling a new set of behavior problems, and redefining their own role in the classroom, were the teachers' first goals.

By the second year, these issues were under control; teachers were more comfortable with the technology and their attention shifted to the kinds of things computers could do for them.

At the final stage, teachers used computers to help manage classroom records, procedures, and materials. They explored new uses of technology and developed instructional approaches that matched the students' increased motivation and expertise. At that point, teachers could not imagine teaching without technology.

When teachers had learned to use the technology to their advantage their attitudes changed as well. In the beginning, teachers worried about the classrooms being too technology-centered rather than instruction-centered. Later, in the impact stage, they described the classrooms as learner-centered. This difference in focus translated into increased student interest and attention. Teachers finally were able to use the technology to increase student motivation and interest while decreasing the number of discipline problems. Students spent more "time on task" and even asked for additional work on the computer. Students also exhibited more pride in their work. They enjoyed producing computer assignments that "look so good," and they enthusiastically shared their latest technological discoveries. When a new software program was introduced in one classroom, the students, rather than asking questions, started exploring on their own.

During the impact stage teachers' attitudes reflected a significant change from worrying about their "computerized classrooms," to worrying about having to teach in classrooms without high-access to technology. Teachers had reached the point where technology had an important impact on their teaching. Although some problems could never be eliminated completely, the benefits significantly outweighed the drawbacks.

Overall Summary

This research study illustrates three significant factors related to teaching in innovative, high-access-to-technology classrooms: 1) Classroom management is not a skill that is mastered once and for all. As classroom contexts change, so do the classroom management issues; 2) Educational change takes time. Teachers tend to focus on the increased workload and drawbacks associated with the innovation before the benefits of change emerge and the innovation takes hold; 3) Teacher change is not unidirectional. Teachers progress through stages of concern in an idiosyncratic manner.

Data analysis showed that like novice teachers, ACOT teachers entering high-tech classrooms were initially concerned with issues such as controlling student behavior, organizing the physical environment, and defining their role in the classroom. In the beginning, teachers felt unprepared to deal with student misbehaviors such as stealing work from other students' disks or ignoring teacher directions when absorbed in certain software programs. With large numbers of computers, teachers had to cope with lack of space, inadequate lighting, and weather that disrupted the flow of classroom activities. Delayed or broken equipment, noisy or bottlenecked printers, and software problems added to teachers' frustrations. Finally, some teachers had difficulty adjusting to a situation in which they were no longer the all-knowing experts standing in front of the classroom dispensing knowledge. Faced with such problems, it was not surprising that teachers focused their energies on changing their classroom management strategies rather than on becoming instructionally innovative. Yet, by the second year, the intensity of teachers' concerns with survival decreased, and they moved into the mastery stage.

Change takes time. If ACOT teachers had been observed for just one year, it would have been easy to conclude that education is not ready for high-access-to-technology environments. This study illustrates the need for long-term examinations of innovations as well as continuing support for the teachers.

When teachers felt more comfortable with the technology, they became adept at anticipating and solving many of the problems. To combat student misbehavior, they restricted computer access and used the technology as a motivational tool. To save time, they used students as resources, and became more comfortable relying on the younger experts. They found ways to organize the classroom and eliminate problems caused by glare, chalk dust, or poor weather. While problems with the software and hardware never completely disappeared, teachers began to take pride in their ability to troubleshoot and repair equipment, and their ability to change plans when problems arose. As teachers became more confident with the technology, they witnessed positive changes in student engagement and motivation, further decreasing management problems.

The most significant changes occurred when teachers moved beyond the survival and mastery stages to the impact stage. At that point, teachers focused on the effects of their teaching on students and began to utilize the technology to their advantage in managing the classroom. They developed electronic recordkeeping systems and strategies for producing more effective curriculum materials. As their confidence increased, so did their willingness to explore new areas of technology as well as instruction. Teachers used the technology to enhance student motivation and decrease discipline problems. In fact, they incorporated technology into their teaching so completely that they couldn't imagine teaching without it. Teaching in high-access-to-technology classrooms had become a natural "way of life."

Implications for the Future

As countless other studies investigating innovation point out, educational change takes time. Data from this four-year study demonstrate that even when classrooms are drastically altered and teachers are willingly immersed in innovation, change is slow, and sometimes includes temporary regression. Unfortunately, agencies or organizations funding innovative programs often expect to see measurable "success" within one year of funding. If ACOT had just been funded for such a short period of time, and if teachers had not had the time to move into the mastery and impact stages, it would have been easy to conclude that education is not ready for high-access-to-technology environments. This study therefore illustrates the importance of investigating innovation longitudinally. Teachers need time to move through different stages of development in order to utilize technology, or any innovation for that matter, to their advantage.

Moreover, those searching for a way to assess the impact of innovation should not expect to see a clear progression through stages. Problems of implementation and adoption may arise, disappear, and then reoccur as teachers and students adjust to the innovation. As schools begin to use more technology in the classroom, teachers will benefit from the insights of the participants in these experimental settings, perhaps avoiding the problems these ACOT teachers have identified. The findings of this study can also inform teacher educators so that future generations of teachers are more fully prepared to utilize available technology and other resources.

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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