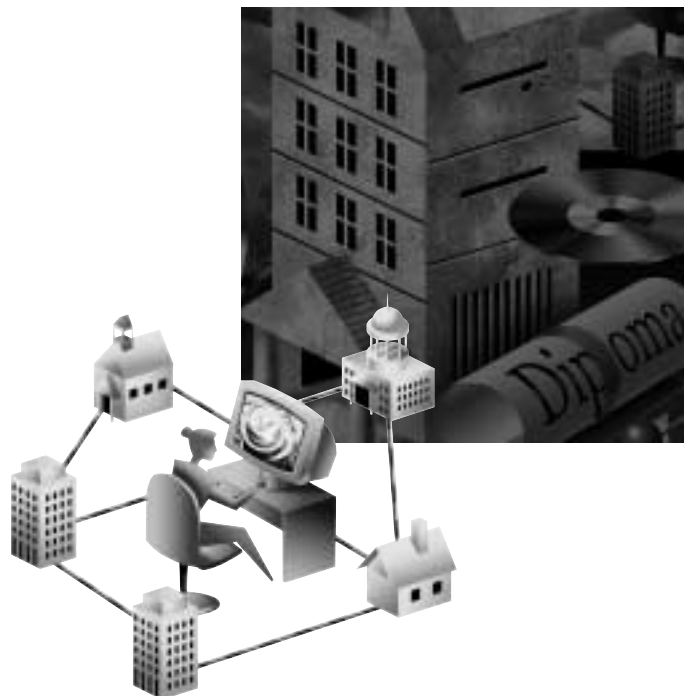




Learning from Lemon Grove.

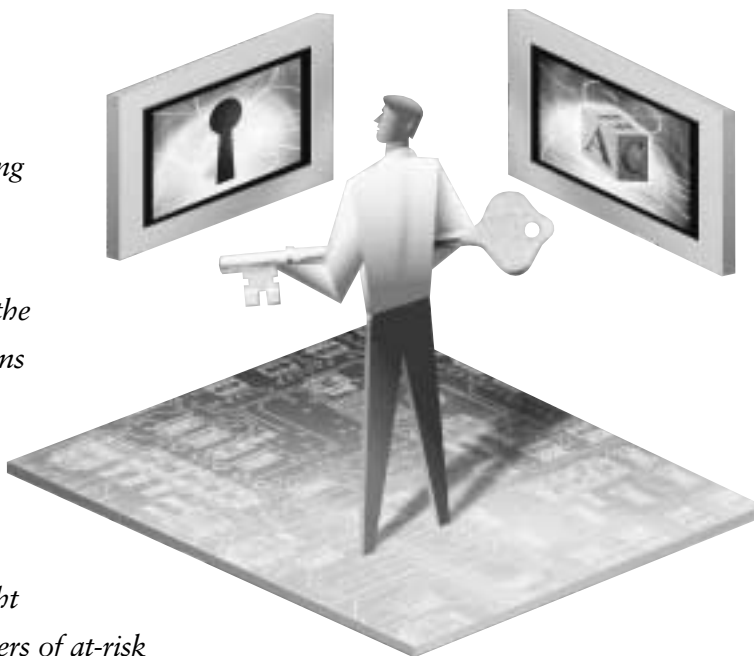
A practical model for computing in education.



Executive summary.

Schools and districts around the world are looking for better ways to build cost-effective, collaborative learning environments by integrating technology into the classroom experience. They need solutions that move technology beyond the computer lab to play an integral and natural role in the everyday life of students, faculty, administrators, staff and even community members.

In southern California, the Lemon Grove School District has been successful in achieving these goals by providing a server-based thin-client computing environment—a system in which a wide range of computing devices at the school, in students' homes or at other locations can access software programs running on centralized servers. Recognized as one of the most innovative school computing implementations in the United States, Lemon Grove's solution overcame tight budgets to improve test scores of large numbers of at-risk students. The Lemon Grove experience provides a model that other schools and districts—regardless of their size—can follow.



Today at Lemon Grove, first graders create PowerPoint® presentations and deliver them to fellow classmates. Teachers build intranet sites that enable students to access the materials they need to participate fully in the class. Parents access the lessons, assignments and school news they need to assist with their children's education. And the district's technology staff delivers a reliable, secure system that meets everyone's needs. The server-based computing solution frees teachers to teach, students to learn and technology staff to concentrate on long-term goals rather than daily emergencies. Students' test scores are on the rise—apparently a direct result of Lemon Grove's technology innovations.

This white paper traces the decision-making and implementation processes that Lemon Grove followed to achieve measurable success with technology. It provides lessons and tips that other schools and districts can use to implement their own server-based thin-client solution.

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The vision: a connected learning community.

The Lemon Grove School District, located outside San Diego, California, is not alone in the educational challenges it faces. The district serves a low-income community where the majority of students are eligible for free and reduced lunches, 17 percent are learning English as a second language and half of schools are on the state's under-performing list. As a result, there is a constant need to achieve full value from its budgets and instructional programs.

This district has a strong sense of mission—to provide a safe, structured and orderly environment through collaboration of parents, teachers, staff and the community at large. Lemon Grove strives for a school environment where students can realize their potential as problem solvers, innovators and users of technology—as well as skilled communicators who are proficient in reading, writing and speaking. To succeed in its mission, the district has determined to make computers an integral part of the everyday teaching process in all its schools.

Early steps toward teaching with technology.

Like many schools, Lemon Grove has been using educational technology for some time. The district's earliest attempts at using computers in the classroom, however, achieved varied success. The attempts tell a story that other districts will find familiar:

- 1993: A network connection and one computer installed in most classrooms. Teachers became familiar with computers and used them for basic tasks such as tracking attendance. But the system offered students little exposure to a computing experience of their own.

- 1994: Television monitors in classrooms. Now teachers could use the Internet and a few applications to present lessons and instruct their classes.
- 1997: Four multimedia PCs installed in each classroom. The small number of computers offered each student just a few minutes of computer time during each class.

Recognizing the need for a new direction.

By 1999, it was becoming apparent that four computers in a classroom of 30 or more students were still not enough to meet instructional needs. The district stood at a crossroad. Though there was some sentiment for continuing with its classroom PC arrangement, and even a desire to add desktops to each room, many educators recognized that the cost of computers would always keep the ratio of students-to-computers high—placing limitations on student use and perhaps on student achievement. Plus, the school's information technology (IT) staff faced another set of problems. Curious students often wreaked havoc with CD-ROM drives and other computer components—creating more support problems than the district's three technicians could handle. The district's technical support problems were beginning to suggest that increasing computer access simply by adding more desktop PCs was not the solution. Besides, the school did not already own the PCs it would need to achieve its goals. Purchasing new ones would be expensive and maintenance and replacement would be difficult to anticipate.

To provide its students with the technology access they needed, Lemon Grove decided to seek a new solution. Knowing that parental support is key to educational excellence, the district wanted a solution

The vision: a connected learning community. (cont.)

that could reach into students' homes, where the learning process could be extended and enriched by parents. And it wanted to stretch beyond campus boundaries to fold the entire community into the solution. The new solution should be affordable enough to break through economic barriers. And it should offer students rich resources that would not otherwise be available to them.

In this way, the district envisioned, technology would become an equalizer in learning.

The community crafts a technology plan.

Creating an effective technology plan requires input from a wide range of people—from the school board and school administrators, to school personnel and technical staff, to families in the community.

One of the first decisions in implementing new technology, therefore, is to create a list of who is going to participate in the development of the technology plan. From Lemon Grove's discussions involving the entire school district as well as the community at large, a set of technology goals came into focus. The district wanted, for example:

- to provide as much interactive learning technology as possible in the classrooms. To achieve this, the district adopted a goal of one computer for every two students.
- to simplify technology maintenance and support. As a result, it began to investigate the purchase of lower-cost "firmware" computing devices with no moving parts, otherwise known as "thin clients," rather than more complex and expensive PCs.
- to provide a uniform foundation of software applications, including both educational

applications and standard business applications, to every school and classroom.

- to give students the ability to fully embrace their school's technology at home—and even do homework using the same software they used in the classroom.

Teachers ensure an integrated curriculum.

For the all-important issue of curriculum development, local professionals rather than consultants also can play a key role. Lemon Grove involved district curriculum leaders in shaping the way technology and instruction were merged and blended. As teachers gained expertise in using technology as a powerful instructional tool, the vision grew of how technology could creatively enhance quality teaching.

Integrating technical staff and educators.

It is also important that technical staff members have an understanding of classroom issues and an appreciation of the needs of teachers and students. In Lemon Grove, the IT department is service-oriented. Frequent interaction with teachers and administrators makes good communication skills a requirement for the technical support staff.

Broad-based participation is key.

By pooling resources and maintaining the focus on technology in the classroom, a school district can accomplish more than with distinct sets of efforts. Technical training and staff development can be coordinated to make a bigger impact on learning. Familiar applications can be standardized from grade to grade. In fact, all aspects of the project, from grant applications to overcoming problems that occur during rollout of a new technology, have a greater chance of success with the backing of the entire district and community.

The solution: server-based thin-client computing from Citrix Systems.

To a large extent, issues of support and cost persuaded Lemon Grove to look beyond PCs for a better way to increase student access to learning. The desire to simplify support and lower cost also helped the district select its technology solution. Purchasing PCs for classrooms and homes, leasing notebook computers for students to carry with them and installing Internet-enabled set-top boxes on home televisions all were investigated and rejected as either too expensive to acquire, too complex to maintain or not supportive of the software programs used in classrooms.

Considering a range of options.

The technology that emerged instead as the best way to deliver interactive learning and, eventually, the desired 2:1 ratio of students to computers was server-based thin-client computing. Under this model, which is made possible by Citrix® MetaFrame™ software, educational applications reside and execute on a central server. However, these applications appear to the student as they would on an a conventional multimedia computer.

Server-based computing enables high-speed performance—even over low-bandwidth connections such as telephone lines—because only keystrokes, mouse clicks and screen updates travel the network between the student’s device and the server. It enables users to access any application using any device, including PCs, notebook computers and even wireless palm devices. And it simplifies support, because students can use “thin” desktop devices with no moving parts to access applications that run on, and are managed and supported on, the server.

Why server-based computing was chosen.

When the school board was presented with the thin-client option, its members were immediately

pleased. The affordable cost, reliability and ease of connecting to students’ homes meant that cash-strapped Lemon Grove would be able to provide a better technology solution than many affluent school districts in the area.

The appeal of server-based thin-client computing was far reaching, with benefits for educators, technical staff and the community at large, due to:

- low cost. Because software applications run on the server, students can use any device, including old PCs and Macintosh® computers that the school already owns. These can be supplemented with inexpensive thin-client devices.
- the ability to integrate into the district’s existing curriculum. Because application use is not limited by a device’s capabilities, schools can choose the applications that best fit their needs.
- community reach. Universal access means that devices outside schools—at homes, libraries, community centers and city hall—also can access software programs.
- easy connections in students’ homes. Server-based computing can work over a telephone line or a home cable TV hookup via the Internet.
- ability to grow. The technology staff can easily add computers and desktop devices to the network as needs change.
- centralized management. A small technical staff can support a large number of computing devices.
- compatibility with learning environments. With thin-client devices, there are no fans to contribute to the noise level and no processors to add heat to classrooms. Space-saving thin-client devices also make efficient use of limited classroom space.

The support: building and maintaining consensus.

Rolling out new technology on the broad scale that Lemon Grove proposed would not only affect every student, teacher and staff member in the district, it would reach beyond campuses to impact many other members of the community. So once the committee of educators and IT professionals determined that a server-based solution was best, a comprehensive consensus-building effort was necessary.

Sharing the vision with the school board.

The Lemon Grove School District's School Board members were not only key players in goal-setting and decision-making, they maintained a keen interest in the project from the pilot program through full implementation. The administrative staff kept board members updated on progress and encouraged them to drop by the technology office to check on the latest developments and try out the technology. As the program progressed, school board members became frequent visitors to the classrooms to observe technology in action.

Recruiting teachers.

Teachers are the key to quality implementation of instructional technology. With this in mind, Lemon Grove initially recruited curriculum experts — rather than technical experts — to give the program credibility among their peers and to ensure that the use of technology would have a strong link to quality instruction. As this pilot group of teachers developed ways to enhance learning with computers, word quickly spread of the positive impact technology could have in the classroom. When the call went out for the next group of volunteers, teachers eagerly signed up. The district's positive approach to change has been responsible for the overwhelming acceptance of technology by Lemon Grove teachers. Working with

lead teachers, administration and teacher union leaders, the district later developed an ongoing professional development program that has been a key to effectively integrating instruction and technology.

Working with the teachers' union.

A project of this magnitude cannot be accomplished during the regular school day. Persuading staff to accept extra effort and extra hours — as much as 120 hours of training in Lemon Grove's case — calls for the assistance of the local teacher's union or association. The key is to bring union representatives into the process early, try to anticipate their problems and talk with them regularly. It is best not to force technology change on anyone. At Lemon Grove, four top union representatives signed up to attend teacher instruction so they could see what was required of teachers. By making the instruction relaxed and enjoyable, the district was able to ensure that the union representatives would report favorably to their members.

Partnering with parents.

The ability of server-based computing to give students access to applications at home — especially the homes of low-income families — helped Lemon Grove gain widespread support from parents. An important part of the district's pilot program was to identify the most at-risk students and to use grant funds and federal dollars available for intervention programs to put computing equipment into their homes. Parents at all income levels began to understand that if children could access their homework, lessons and instructional files from home — this would boost student achievement.

The budget: calculating cost and finding funding.

With limited budgets for basic services, salaries, instructional materials and physical plants, it can be difficult for a district to find the funds for any new program—including revamping its computing architecture. It is likely, therefore, that a district undertaking such a program will seek financial assistance from federal, state or private grants organizations.

As a part of this process, the district must seriously examine its technology budgets more thoroughly than ever before. It is not uncommon, for example, for a school district to provide adequate funding to purchase equipment then fall short in funding ongoing maintenance and support. A comprehensive cost analysis of the technology plan is therefore imperative.

Facing the competition for grant funds.

Any school or district applying for a technology grant today will most likely encounter a great deal of competition. Examining the district's overall technology picture and smoothing out any problems with its existing infrastructure or support staff are therefore important early steps toward improving the chances of outside funding.

Throughout the grant application process, the Lemon Grove School District remained in constant, close communication with the State of California's Department of Education. The result was both direct and indirect financial assistance. The state provided the district with two grants for its server-based solution: one \$3.3 million, five-year grant and one \$1 million, four-year grant. In addition, the district negotiated a waiver of the state's education code to enable leasing thin-client devices to parents—lowering the district's hardware purchase requirements.

Tips on applying for a grant.

Every funding organization has its own procedures and rules, which must be followed closely. However, there are certain general rules to remember:

- apply for grants at least six months ahead of the technology program's anticipated start date. It takes that long to complete and file the paperwork and perform the necessary evaluations.
- a similar period will be necessary to create partnerships with software vendors and others who might be willing to contribute to the project.

Applications for financial assistance will require an independent evaluation of the district's technology infrastructure and its proposal. It is important that the evaluator have experience with federal and state grants. The evaluator can be either from the school district or an outside organization:

- an in-house evaluator will be familiar with the district's vision, challenges and requirements.
- an outside evaluator will have extensive experience and knowledge in collecting the data necessary for a successful grant. Lemon Grove employed an outside evaluator.

The funding organization must fully understand what the school or district is attempting to accomplish. In writing a successful grant application the school district must:

- be able to articulate its goals and objectives.
- have processes in place to measure success even before beginning.

The ability to measure success is critical. An applicant that has not identified a way of measuring success up front probably will not receive funding.

The technology: hardware, applications and partners.

One advantage of server-based thin-client computing is that it enables a school district to use a variety of computing devices, including PCs running on Microsoft® Windows® or UNIX® platforms, Macintosh computers, thin-client devices, and hand-held and wireless devices. This variety presents tremendous flexibility and opportunity for a school district—but it also adds a step to the decision-making process. A district must examine a range of products and decide which ones best meet its needs and budget.

Selecting classroom hardware.

Lemon Grove chose to supplement its existing classroom PCs with 1,500 inexpensive Windows-based terminals. These thin-client “firmware” devices have no moving parts and no computing power of their own. Instead, they display server-based applications on full-size desktop monitors. These terminals could be easily integrated with the district’s aging PCs to improve the student-to-computer ratio. (Currently, the district has achieved its 2:1 student-to-computer goal in 80 percent of classrooms. Lemon Grove is on track to achieve this goal in all classrooms within five years of implementing the program.) Windows-based terminals also proved to be the ideal choice for use in students’ homes, thanks to their low price and compact size.

Selecting educational software.

Approximately 85 percent of all Windows-based software applications available today will work well in thin-client environments. At Lemon Grove, any teacher is free to ask for a specific application. Information services conducts an evaluation and, if the software is approved, deploys it to a pilot network. If the pilot is successful, the software is deployed to a test group of classrooms before it is rolled out to the entire district.

Through this process, the district has created a custom suite of applications that it calls LemonLINK. LemonLINK provides a range of innovative educational tools:

- Microsoft Office 2000, Microsoft Internet Explorer, NCS Learn (formerly CCC), Scholastic Reading Counts literacy program, Southwestern MicroType Pro typing tutor, ProQuest Direct and Microsoft Encarta Encyclopedia.
- LemonAids, a set of instructional tools that teachers use to create customized Web-based instructional materials and assignments.
- Epicenter, an interactive Web-based desktop designed by Lemon Grove, gives students and parents the ability to access school resources at home.

Establishing corporate partnerships.

One popular way for schools and districts to acquire technology, implement solutions, train staff and help reduce costs is to form partnerships with corporations in the business community. Many companies respond positively to the public relations aspect of such partnerships. Others partner with districts so they can demonstrate to future customers that they can meet their technology needs. Still others use schools as laboratories to help develop new products or test existing products for the education market.

At Lemon Grove, establishing partnerships was slow at first. But once it began winning awards, the district began to attract the attention of technology companies. Eventually, corporate partners working to help Lemon Grove establish its technology program and extend it to the community included Allied Telesyn, Cisco Systems, Citrix Systems, Compaq Computer Corporation, Cox Communications, GTC Systems, Hewlett-Packard Company, Microsoft Corporation, NCS Learn and Wyse Technology.

The pilot program: test early and often.

With policies and goals established, architecture selected, educators and community lined up behind the program, funding in place and decisions made regarding hardware and software, the time arrived to implement the district's new technology solution. There was, however, still a way to go. Lemon Grove rolled out its technology plan one cautious step at a time, slowly introducing it to administrators and teachers while ironing out the bugs and increasing staff expertise.

Taking the first step toward rollout.

First came IT training. Lemon Grove permitted its technology team to spend three months experimenting with Citrix MetaFrame servers and attending classes before moving forward with the program. Then came system testing, a pilot program and rollout to a few classrooms. Finally, one entire school was connected, tested and evaluated. Only then was the system extended to other schools in the district.

Learning from the integrator.

The actual implementation of any server-based solution begins with a value-added reseller. Among the services the reseller generally provides are training and support for technical staff. Technical training and integration services are additional expenses, however, that can add up to several thousand dollars extra.

This can be a difficult expense for some cash-strapped districts to justify when they already have their own IT staffs. However, the IT professionals at Lemon Grove found an integrator was invaluable. They believe that many school technology projects of this magnitude will be able to avoid difficulties and will run more smoothly with expert help. They recommend pairing a staff technician with an integrator and making sure that the consultant explains exactly how to do what needs to be done. In this way, the process becomes more than a technology implementation. It becomes an educational experience and a growth opportunity for the IT staff.

Beginning with a pilot program.

A successful technology transition will include a well-planned pilot program six months before actual deployment. The first step is to make sure everyone agrees on exactly what will be piloted. Lemon Grove, for example, wanted to pilot a server-based thin-client environment using Citrix MetaFrame and Microsoft Windows Terminal Server software. The district sent IT staff members to Citrix and Microsoft training programs. Then it set up its pilot program with three servers used exclusively for the program. The implementation was tested over six weeks during the summer session in three classrooms with teachers who were not technologically oriented.

Eight-month rollout to the first school

- Three months to:
 - Train technology team
 - Evaluate client options
 - Set up pilot servers

- Six weeks to:
 - Identify software programs
 - Test software for environment
 - Showcase technology for teachers

The pilot program: test early and often. (cont.)

At first, nothing worked. Frustrated IT staff members investigated all network elements from servers to the wide area network (WAN), until they discovered a problem with a device that ties the network hubs together. The problem was only intermittent and barely noticeable with the existing arrangement of networked desktop PCs. It quickly became apparent that a stable network would be key to a successful project—since server-based environments concentrate the power of computing at the center of the network rather than on distributed desktop PCs. It also became apparent that a thorough pilot program would be necessary to avoiding frustrations and problems once the new architecture was deployed.

Teaching the teachers.

While the IT staff was learning how to make the technology work for the schools, teachers were learning how to make the technology work for the students. This manner of approaching staff development—allowing teachers to discover and experience the technology with little risk in a test pilot environment—proved to be an ideal way to encourage innovative thinking about Web-based instruction.

One important goal for the Lemon Grove project was to have all classroom teachers trained to effectively use educational technology within five years. Each year, 20 percent of the teaching staff joins the project and each teacher receives approximately 120 hours of training. To date 80 percent of Lemon Grove

teachers have been trained to integrate technology into instruction.

Ongoing staff development.

Staff development at Lemon Grove is an ongoing process. To facilitate training and integrate it with the daily life of the schools, the district adopted a collaboration and coaching model in which teachers learn from each other.

Today experienced teachers coach those who are new to server-based technology and trade tips and techniques throughout the district. Teams were created within schools, grade levels and curriculum areas to provide support and encourage sharing of ideas. But it is not uncommon for teachers to cross from one team to another—as kindergarten teachers visit eighth grade classrooms or eighth grade teachers go into third grade classrooms, for example, to learn from each other.

The district even provides substitutes who free teachers to visit other classrooms to learn new techniques and technologies by observing their peers. And the district has created a program called “Guide on the Side” that helps teachers evaluate classroom management, student interaction, the teacher’s role and other topics as they visit classes.

■ One month to:
Purchase classroom
equipment
Deploy to the classroom

■ Six weeks to:
Implement in three classrooms for
summer session
Staff reviews successes
Classroom design established

■ One month to:
Deploy to rest of the school

The pilot program: test early and often. (cont.)

Rolling out the new technology.

Lemon Grove's methodical approach to the rollout meant that it took eight months to provide server-based technology, at the ratio of one computer for every two students, to one entire school with 250 desktop devices (see chart on Pages 7 and 8). But it also meant that the IT staff understood all the details required for the rollout, the instructional staff was prepared to use the new system and the technology and its infrastructure worked well.

Lemon Grove was careful to involve the entire education community as well—not just the technical staff. Teachers involved in the early phases of the project, for example, were asked to keep journals that chronicled the rollout from the end user's perspective.

Through these journals, the district was able to gather important insights about teacher and student involvement, as participating teachers answered questions that ranged from the specific (“How many times did students use the Internet to complete an assignment?”) to the general (“What are your concerns?”).

The gradual approach is better.

Proof that the gradual and inclusive approach was the correct one lies in the ease and speed with which the server-based system was deployed to subsequent schools. With a well-trained IT staff and well-planned installation methods now in place, the second installation required only four months for 290 terminals. And the third took just two months to install 340 terminals—with 16 new network connections in every room—even though the building required extensive rewiring.

While some school districts try to install new technology all at once during the summer and introduce it to teachers shortly before the school year begins, the

Lemon Grove experience clearly shows that a slower rollout is better because it provides time to really test the system, train staff and allow teachers to develop lesson plans for Web-based instruction.

Putting the solution together.

Today, the Lemon Grove School District maintains a central “farm” of more than 30 servers that provide users with access to data and applications via a wireless fiber optic WAN. State-of-the-art links from a microwave tower located at the district office connect 23 sites—all schools and a number of city facilities including city hall, the fire department, public works, the recreation department, the community center, the teen center and the senior center.

With Citrix MetaFrame and Microsoft Windows 2000 servers deployed throughout the network, all computers in every classroom can access the Internet and the district's suite of educational applications from a range of computing devices. The typical classroom for kindergarten through grade three has three PCs and eight thin-client devices. A typical classroom for grades four through eight has four PCs and 12 thin-clients.

Through a partnership with Cox Communications, the cable television provider for the community, Lemon Grove delivers high-speed cable-modem connectivity between the district and students' homes. These connections enable students to access the Internet and school resources from any computing device—full-function PC, notebook or thin-client device. The Internet connection is filtered to provide access to education-related sites only.

The results: big gains from those with the lowest test scores.

The point of technology in education is to assist children in realizing their potential as students, problem solvers and innovative learners. To determine whether its computing approach has been successful, Lemon Grove sought to measure the progress of students who, rather than being passive learners, were emerging as active participants. Lemon Grove wanted to investigate whether its students are growing into a different type of a learner—and whether children are learning to think for themselves, find information, process it and turn it into knowledge.

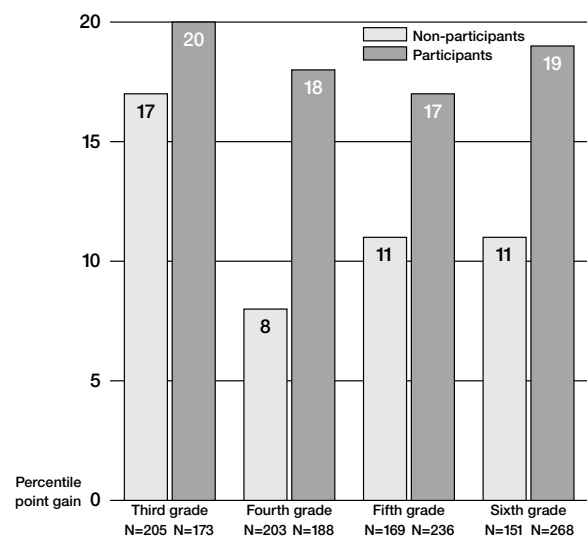
Measuring student progress.

Like most schools, Lemon Grove uses standardized tests as a measure of student achievement. To determine the impact of technology, a team of external evaluators tracked scores on state-initiated standardized tests over several years and compared the test scores of students with access to the computers to scores of those without access.

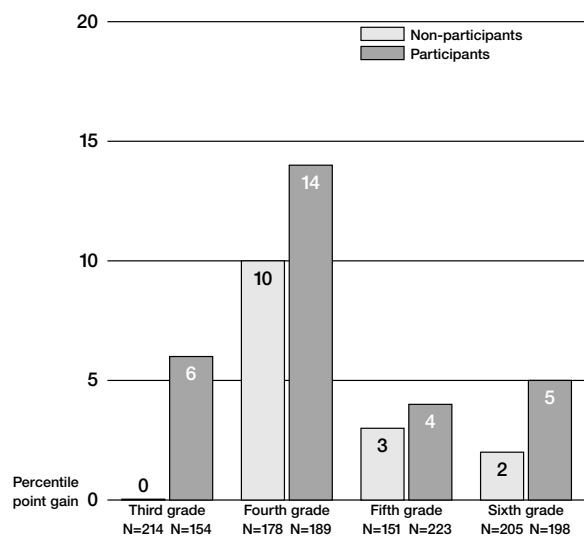
When Lemon Grove passed the mid-point of its technology implementation—with 60 percent of teachers trained and 60 percent of classroom installations complete—the district compared matched test scores from the state-initiated SAT9 for students regularly using computers and matched test scores for those without computer access. The comparison for grades three through six revealed significant gains for all students in both math and reading. But many students who used computers registered increases of as much as 20 percentile points.

The district also found that technology provided new ways for students to demonstrate knowledge and understanding not possible through traditional instruction. Many previously low-scoring students improved their skills to grade level and beyond. And

many of the biggest gains—as reflected in both standardized scores and teacher observations—came from students who originally had some of the lowest test scores. When coupled with quality instructional practices and a focus on standards-based instruction, technology has proven to be a powerful tool for teaching and learning.



MATH



READING

The results: big gains from those with the lowest test scores. (cont.)

Educators attribute the improvement in test scores to several factors. Among them is the fact that technology gives teachers more flexibility in tailoring lessons, so the students receive more of the instruction they need. Server-based computing also frees teachers to focus on the job of education rather than worrying about troubleshooting hardware and software.

Computer-assisted learning also provides intangible results. Educators at Lemon Grove feel that technology enhances students' creativity, independence and general skill level—and that students take more responsibility for their own progress because their actions and attitudes can have greater influence on their own learning experience.

Reducing cost of application ownership.

In addition to studying the system's effectiveness for students, the district also wanted to explore how efficient the new system was in reducing the cost of using technology in schools. What it discovered was that server-based computing can help reduce expenses that arise from capital, management, support and end-user needs in several ways:

- controlling the cost of new hardware purchases
- lowering the cost of support and administration
- lowering the ratio of students to computers
- supporting environments that include different types of hardware and operating systems

Lemon Grove, in fact, has devised a formula for calculating cost-savings over a 24-month period. The formula compares the cost of using Windows-based terminals in a server-based environment to the cost of using freestanding multimedia PCs with software programs loaded on local hard drives.

The district begins with a purchase price of \$1,700 for the PC and \$500 for the terminal. It then assumes six visits during the 24-month period to conduct maintenance on the PC and two remote support instances for each thin-client device. It adds costs to upgrade that same PC—for example from Microsoft Office 97 to Microsoft Office 2000. And it considers the cost of hardware upgrades and additional memory to run the new applications.

The final figures show that the district can purchase and support three thin-client devices for the cost of one multimedia PC. In addition, Lemon Grove expects to keep its thin clients in service at least eight years before replacements are required—considerably longer than the three-year life cycle of a typical PC.

For school districts of all sizes, the results show a cost-effective way to provide simplified management for IT staff, new and effective instructional tools for educators and—of ultimate importance—a collaborative learning environment that helps students achieve their greatest potential.

Conclusion.

Like many educational entities, the Lemon Grove School District has used computers in the classroom for more than a decade. However, the district's computer network—which placed a limited number of PCs in each classroom—was not able to provide the rich instructional experience that educators wanted. And when the time came to decide whether to continue with its existing system or to adopt an entirely new architecture, Lemon Grove chose a new direction. It adopted a server-based thin-client architecture—with remarkable technical success and educational results.

In planning its new computing solution, Lemon Grove took a broad view of its needs—ranging from student goals to staff development to school construction and renovation. The district involved the entire educational community, from the school board to teachers to parents. Lemon Grove's goals, however, were well defined—and achievable:

- place more interactive learning technology in the classroom
- simplify technology maintenance and support
- create a uniform foundation of software applications
- enable students to use educational technology at home
- make it easier for parents to be involved in their children's education

Implementing a server-based architecture took a careful path that methodically addressed technology, funding, teacher training and other issues. The district worked closely with the state Department of Education, value-added resellers, technology integrators and corporate partners. The process took nearly a year. But in the end, Lemon Grove has a new system that not only

works smoothly, but also enables the district to meet all its original goals. Lemon Grove also developed a methodology that will expedite future rollouts.

Server-based thin-client computing helped Lemon Grove decrease its computing costs, simplify technology management and make substantial progress toward lowering its student-to-computer ratio to 2:1. The server-based solution has freed teachers from technical worries so they can spend more time and effort teaching, provided connections to students' homes and contributed to significantly raising student scores on state-administered achievement tests.



Appendix:

10 tips for deploying server-based computing.

The experiences of a technology pioneer like the Lemon Grove School District can provide valuable insights for districts of all sizes that are planning to deploy a server-based thin-client computing solution of their own. Here are 10 tips from Lemon Grove that will help other districts implement this technology. They are presented chronologically, in the order in which a school district will encounter them.

- 1 – Create a technology plan. Identify specific individuals from the entire educational community — not just technical staff — who will participate. Through these people, establish well-defined, attainable goals.
- 2 – Select technical staff members for the project who understand the educational issues involved, who appreciate the needs of teachers and students and who interact well with children.
- 3 – Ensure from the very beginning that the district’s network is stable. A server-based computing environment will not function properly if there are flaws in the network.
- 4 – If the network has problems, make sure they are remedied before applying for grants or other financial assistance. A smoothly running network will improve chances of receiving funding.
- 5 – Make full use of a local, experienced systems integrator with access to network troubleshooting tools. Pair a staff technician with the integrator to make implementing the solution an educational experience. Take advantage of training and support offered by the project’s integrator.
- 6 – Form partnerships with corporations in the business community. These companies can provide a range of benefits, from pricing discounts to training and support.
- 7 – Identify the different phases of the technology rollout and schedule enough time to address each one successfully. Include IT and teacher training, system testing, a pilot program in the data center, limited rollout to a few classrooms, rollout to one school and, finally, rollout to the entire district.
- 8 – Build in evaluation processes for both hardware and software. Establish a test-bed where technology can be thoroughly evaluated before placing it “live” on the network. Ensure that evaluation procedures can be easily extended into the future as the district’s needs evolve.
- 9 – Centralize servers in a data center rather than placing them in individual schools. A data center enables the district to take full advantage of the simplified management capabilities of server-based computing. The data center also creates economies of scale and allows easier IT management.
- 10 – Roll out the technology plan slowly to confidently build staff expertise and iron out bugs. Begin the pilot six months before the actual deployment. Do not rush the program. At Lemon Grove, the rollout took nearly a year.

Appendix: technology impacts classroom design.

The evolution of the classroom.

Deploying new technology can change life in the classroom—both in regard to instructional methods and what the room looks like. In fact, classroom design can prove to be one of the most difficult transitions associated with a new technology program. A school must remain open to experimentation until educators find the design that works best for them.

With one computer terminal for every two students, for example, the focus of the classroom changes. The teacher's desk and blackboard at the front of the room are no longer the center of attention. At Lemon Grove, experimentation with classroom design began during the pilot program, but it took the effort of several teachers trying out desk arrangements to come up with a solution that works for most classrooms.

A successful design emerges.

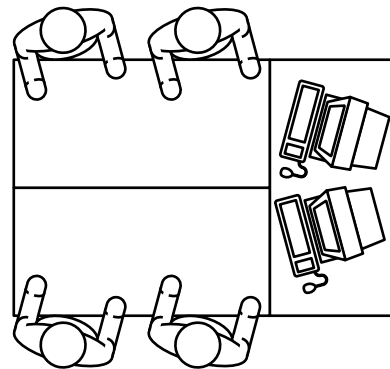
One early design created an “L” shape in each corner of the room. Monitors were turned toward the wall, and students working at the terminals faced the center of the room. But to a teacher standing at the room's center, the children were lost behind the screens.

Then, one instructor began experimenting with configurations of small 2' x 4' desks. By grouping three desks together, the teacher was able to create a “pod” of desks that seemed to fit the classrooms well, while allowing easy communication between teachers and students.

Finally, an arrangement with six pods of desks on the perimeter of the room proved to be the optimal arrangement. With this configuration, students have computers right at their desks. However, once the desks are arranged in pods and the terminals are installed, teachers are not able to move the furniture as easily as they might have in the past. Rearranging the pods and terminals requires the help of a technician.

Involving teachers in classroom design.

In deploying a new technology solution, it is crucial to involve teachers in classroom design. When asked to choose between the pod arrangement and a more traditional desk arrangement, teachers in the Lemon Grove School District overwhelmingly chose pods. This arrangement is now the most common classroom design in the district.



Lemon Grove's pod arranges groups of four students around three desks holding two thin-client terminals.

Appendix:

Lemon Grove at a glance.

Lemon Grove School District, Lemon Grove, California:

- 4,600 students, kindergarten through eighth grade
- majority eligible for free and reduced-cost lunches
- 17 percent learning English as a second language
- 31 languages spoken in the district

Lemon Grove technology goals:

- long term goal: one computing device to every two students
- Internet and intranet access for every computing device
- computers available for student home use with cable modem access
- intranet site for access to custom instructional tools and resources
- community education through partnerships with local colleges

Lemon Grove software deployed:

- LemonLINK, a suite of custom applications that provide innovative educational tools
- Microsoft Office 2000
- Microsoft Internet Explorer
- NCS Learn (formerly CCC curriculum testing software)
- Scholastic Reading Counts literacy program
- Southwestern MicroType Pro typing tutor
- ProQuest Direct
- Microsoft Encarta Encyclopedia

Lemon Grove computing infrastructure:

- 30 servers running Citrix MetaFrame application server software
- Citrix NFuse™ Web application publishing software
- Citrix Load Balancing Services
- Citrix Resource Management Services

- Citrix Installation Management Services
- Microsoft Windows 2000, Advanced Server
- wireless fiber optic WAN with microwave links
- cable modems from Cox Communications
- 1,500 Wyse® Winterm™ Windows-based terminals
- several hundred PCs

Awards and recognition:

- 2000 Computerworld Smithsonian Award
- 2000 National Technology In Education Leadership Award
- 2000 American School Board Association Magna Award
- 1999 *Business Week* Magazine Smart Links Award
- 1999 American Association of School Administrators Promising Practices Award

Technology partners:

- Allied Telesyn
- Cisco Systems
- Citrix Systems
- Compaq Computer Corporation
- CornerPost SoftWare
- Cox Communications
- EDmin.com
- GTC Systems
- Hewlett-Packard
- Microsoft Corporation
- NCS Learn (formerly Computer Curriculum Corporation [CCC])
- Wyse Technology

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