Lemon Grove Middle School
Case Report from the
U.S.A. Exemplary Technology-Supported Schooling Case Studies Project

Lemon Grove Middle School: Academic Performance and Excellent Technology Support through Thin Clients and Professional Development

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This report is a
DRAFT March 2003

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The U.S.A. Exemplary Technology-Supported Schooling Case Studies Project was a part of international studies sponsored by IEA and OECD.

International Association for the Evaluation of Educational Achievement	Organisation For Economic Co-Operation and Development
  IEA's *Second International study of Technology in Education* (SITES) consists of three modules. SITES Module 2 (M2) is an international qualitative study of innovative pedagogical practices that use information and communication technology (ICT). The final project report and cases from participating countries can be found at http://www.sitesm2.org/	 The OECD case studies project, *ICT and the Quality of Learning*, is a major international initiative organised by the Center for Educational Research and Innovation (CERI) within its work on Schooling for Tomorrow. This initiative is concerned with the profound implications that ICT has for education and learning and involves many of the 30 OECD member countries. The final project report and cases from participating countries can be accessed at http://iol3.uibk.ac.at/ICTandSchooling/caseStudies/

Lemon Grove Middle School: Academic Performance and Excellent Technology Support through Thin Clients and Professional Development

Case Overview

This suburban middle school with 800 students in grades 6-8, seventy-five percent of whom were eligible for free or reduced price lunch, resides in a district with an exemplary project called LemonLINK. This project started with a vision of improving teaching and learning utilizing an information infrastructure dominated by thin clients (network PCs lacking local diskette or CD-ROM storage devices) in classrooms. The district also provides these thin client computers free or at low cost to parents without home computers. Furthermore, the district provides ISP services to local government agencies.

Essential to the success of the program is a strong professional development program providing every teacher in the school with a minimum of 120 hours related to technology during the first year. Equally critical to the program is a very extensive technology support system, which is made more feasible and less costly by the thin client system whereby most software and database services are managed at the district site servers.

While the program encourages and supports all types of pedagogical approaches including inquiry and project learning, a major emphasis is on remedial activities and other technology applications that help to improve student achievement. Test score gains for the school are consistent with their program goals.

Implementation Context

History of the Innovation

The evolution of the use of educational technology at Lemon Grove Middle School began with the district's work ten years ago. This precipitated the district's 1997 Technology Challenge Innovation Grant from the U.S. Department of Education, which is named LemonLINK: A Connected Learning Community. This grant project contributes to the current ICT infrastructure and goals at Lemon Grove Middle School. The LemonLINK project and its emphasis on literacy provided the focus for Lemon Grove Middle School's efforts to raise students' academic performance levels. The Director of Information Systems Daryl LaGace and the LemonLINK Project Director Barbara Allen lead the district's ICT efforts.

In 1997 the district received a grant that funded development of a linked IT infrastructure called LemonLINK. This infrastructure served as a catalyst in the school's use of technology to improve students' academic performance by providing ICT training to all district teachers, technology support, and ubiquitous classroom computer access (at a 2:1 student to computer

ratio). LemonLINK also provided the CCC Program training to the reading and mathematics teachers. The beginning of the 2000-2001 school year marked the full school implementation of thin client computing throughout the school, with a 2:1 access ratio, and 100% staff completion of the year-long professional development program. In 1998, in order to reduce hardware costs and make quality technology support more sustainable, the Lemon Grove School District decided to implement server based computing and thin clients. The district partnered with Wyse Technology in the development of a classroom-suitable thin client model called a Winterm.

The move to thin clients meant that the district could economically and efficiently provide this same computer service to homes. The district worked with Cox Communications to provide high speed Internet access through the cable TV lines and a cable modem as part of the district's "Home Connection" program. District students that were considered at risk received free Winterms and Internet access in their homes. Other homes were able to lease the Winterm and receive the network services for a $30 per month charge, which is a self-sustaining rate.

School Culture, Professional Community

Cultivating a schoolwide shared vision on specific instruction and assessment approaches was not an important aspect of the school's participation in LemonLINK. Instead, the LemonLINK project emphasizes that learning to teach with technology is an evolutionary process, and that for teachers to learn, professional development programs must create a positive learning environment that addresses their needs and concerns and provides appropriate support (emotional, collegial, and technological). In the professional development program, teachers may begin learning in the areas in which they feel most comfortable. Some chose to begin with teacher-centered uses and others with student-centered uses of technology. Because the district and school administrators encourage sharing and collaboration, teachers are able to see new integrative practices without feeling pressure to change their instructional style.

Lemon Grove Middle School capitalized on every opportunity afforded by the project's professional development and computer access programs. In LemonLINK's first year, the entire team of Lemon Grove Middle School grade six teachers (ten people) attended the technology staff development training camp. We observed and/or interviewed four of these teachers in-depth. One of them indicated that without the team approach, she never would have chosen to participate the first year. She said that she was not a risk taker and hadn't previously known how to "use a mouse." For her, the project design provided the support and push she needed to be successful:

> The sixth grade team getting together and sharing… we did a lot of informal sharing, and I can't stress strongly enough, how valuable that was for us to go through as a team, to work together, to learn together and to be sharing. To me that was everything. I think if I had been in a group, where I was at this school and someone else was over there and another was at a different grade level and this one taught a different topic, I don't think there would have been that kind of bonding and sharing that went on. I really think that's what has pushed us and made us grow.

Since their completion of this training, several of these teachers have been instrumental in teaching classes in the summer technology. Lemon Grove Middle School teachers' aggressive

participation in the technology training resulted in all of them having completed the LemonLINK professional development by the end of year three. While the LemonLINK project provided the context and opportunity, Lemon Grove Middle School as a staff took actions to ensure its teachers were equipped with the needed technology skills to effect change in curricula and instruction and that equitable computer access was available to all of the school's students. The principal commented on how at Lemon Grove Middle School teacher collaboration on technology use is a part of the teaching culture, "They share curriculum, things they have developed through the Internet, or web pages they have for their class."

The principal explained that the excellent technology infrastructure the district has put into place allows him to focus on what teachers are doing with it in the classroom. He described his main efforts as encouraging its use and pushing people to grow in their use of technology:

> Continue to encourage people to use it [the support]. And a big part of it is listening. Listening to the dialogue that's going on between teachers. Listening to the dialogue and vocabulary that the students are using….I think the fact that we have tremendous District support, makes a huge difference. Because for me to keep up on the technology, with all the other tasks and demands that I have, I don't believe would be possible. So I'm not going to be the technical person on the cutting edge. That needs to be someone who specializes in that. My job is to continue to support that and work with the technology and work with teachers in integrating that. And making sure that they understand that it is an expectation from my leadership. That we will all embrace technology and that we will all continue to work with it. Now I will see teachers at different stages, of that development. My job is to make sure that they continue to move ahead.

Technology and Technology Support Structure

The technology support structure for Lemon Grove Middle School is mostly provided by the district, as a part of LemonLINK. It is a robust structure, with extensive instructional support and responsive technical support.

The objectives for LemonLINK's professional development were: 1) to know how to incorporate Internet/Intranet use and quality educational software in the daily activities of the classroom; 2) to be able to facilitate students' access of information worldwide as an integral part of the learning experience; and 3) to learn and adapt new modes of instructional delivery and move away from traditional delivery talk/lecture/dictation approach. To accomplish these objectives LemonLINK Project Director Allen developed an extensive staff development training plan. During each year of the five-year grant twenty percent of teachers in the district attend a two-week paid summer "camp" and follow-up sessions throughout the school year. By the end of the 2001-2002 school year 100 percent of the district's teachers will be trained. Training sessions cover a broad range of software and instructional skills, as indicated in these titles: Technology in Literacy –Based Curriculum, Developing Standards-Based Projects Using Technology in the Primary Grades, Building a Classroom intranet to Deliver Instruction, Microsoft Office in the Classroom, CCC Reading Adventures, and PowerPoint/Digital Camera Revisited.

The district also provides the technical support teachers receive. The district technology leaders' commitment to quality technical support led them to implement the thin clients, which are easier

to maintain than desktop computers. One technician monitors and provides technical support for 2000 thin clients. The district's means that teachers usually receive same day service for any technical difficulties they encounter. The thin client model means that these computers are simply serving as terminals for the processing occurring back on the servers centrally located at the district office. One server can host about 60 users at a time; the district currently has 35 servers in a networked, load-balanced group referred to as a "server farm". As a result, often any problems with these computers can be resolved in minutes of calling the technician. Besides the ease of technical support and upgrades, Director of Information Services LaGace explained some other benefits of the Winterms,

> The great thing about the thin client is that…you can't load something on it, you can't steal something from it. It is a worthless device without being plugged into our network. The beauty of it, is that for example when we upgrade from Office 97 to 2000, we did it in four hours on about 35 servers overnight and the next day they [the users] turned on the one button that is on that machine, the on-off button.

The fact that there are no disk drives and that you can't load something onto a thin client can also be a limitation, such as when teachers have CD-ROMs they want to use in class. It is for this reason that every classroom has four regular desktop, multi-media computers as well.

Because a thin client costs only one-third to one-forth as much as a desktop computer, the district was able to provide each teacher with 4 desktop CPUs and twelve thin clients. With sixteen computers per class, teachers now have the flexibility they need to have technology as an integral part of instruction.

Also, using thin clients allowed the district to provide this same computer service to students' homes. The district worked with Cox Communications to provide high speed Internet access through the cable TV lines and a cable modem as part of the district's "Home Connection" program. District students who were considered at risk received free Winterms and Internet access in their homes. Other homes will be able to rent the Winterm and receive the network services at a self-sustaining rate. The district's LemonLINK home connection provided parents with a low-cost computer and Internet service plan that enabled them to have in-home computer use and support, and 24 hours a day, 7 day a week access to school and class information and curriculum, including the CCC program.

The district technology personnel explained that they wanted to free teachers of dealing with technical support problems, so that they could begin thinking about how to use the technology in their curriculum to improve student achievement. Teachers are extremely complimentary about the level of technical support. A seventh grade social studies teacher commented,

> I have sixteen computers in my room, and if something goes wrong, I can pick up the phone, call the technology department at the District office, and know that … somebody is going to get on it pretty soon. Often times within that class period.

The ICT software at Lemon Grove Middle School is a combination of practice software, and tool software (such as Web browsers, and word processing). Teachers observed that each type of software contributes in its own way to students' reaching higher achievement standards or acquiring new skills.

Context Beyond the School

The school's improvement effort (also shared by other schools in the district) was stimulated in part by state policy related to the Academic Performance Index (API) score. Developed by the state as an overall measure of the school's students' academic growth, the API is based solely on the SAT9 test scores. Lemon Grove M.S. had to improve its API score and continue to meet an improvement target (created by a formula that includes weighting lower scoring students' improvements more heavily each year). Principal White explained, "It [the standards and accountability movement in California] is a tremendous influence. It dominates our conversation. There is no question about that. It's something the state is saying, this is what our expectations are as a school. That carries a lot of weight."

A goal of Project LemonLINK was that "through development of a community Intranet which would provide access to parents of students, community members, city government, community facilities, parochial school, and the local library, web-delivered applications would be available not only to their students during the school day, but to the entire community 24 hours a day (grant proposal site document)." The project included many partners, including companies such as Microsoft Corporation and the local cable service provider Cox Communications, as well as city, county, and state agencies, and post-secondary education institutions. This strong group of partners provided avenues for substantial collaboration and support.

Classroom aspects of the improvement

Curriculum and Assessment Aspects of the Improvement

Lemon Grove implemented a combination of technological and non-technological strategies for improvement. The district provided Lemon Grove Middle School's teachers with the necessary equipment and technology training to direct ICT towards raising students' academic performance.

The CCC and Scholastic's Reading Counts programs the teachers used provided unique capabilities for them, serving as a catalyst for the particular approach they used to define progress and readiness. All mathematics and reading, language arts teachers at Lemon Grove were trained in how to produce and interpret students' CCC progress reports. These reports provide important student progress information that teachers may use to assist them in planning individual remedial work. Because students' progress on math and reading skills are important for their success on the State required SAT9 test, CCC reports help teachers know where students need additional help.

Teacher Practices and Outcomes

Teachers focus on using technology to improve student academic performance. The most direct method is through the use of the CCC program, a skill development program that Lemon Grove Middle School teachers use in math and reading. The CCC program provides teachers with a means to diagnose and re-mediate students according to their individual levels and areas of deficiencies in mathematics and reading. As the principal put it "The technology helps to create a

data leap. It is an interim assessment tool, and helps us to see progress in small
pieces."

The CCC program was the primary technological method that teachers used in math instruction;
in reading instruction teachers used CCC as well as Reading Counts and Reader's Workshop.
The CCC program provided students with regular 15 minutes intervals of skill-based practice in
reading and mathematics. The reading programs encouraged kids to read books by selecting titles
that matched their reading level and interests, then allowed them to earn points when they
answered questions correctly about their content. In addition, the various tool software extended
and enriched teaching and learning opportunities.

But in addition to sheer access, the Lemon Grove teachers found that how the computers are
arranged is important for what you can do with them during instruction. In many classrooms,
computers have been arranged into "pods," where three tables are arranged in a "T" shape. The
computers are positioned where the arms of the T meet its body. This arrangement allows up to
two students, one on each side of the computer, to sit at their regular classroom seats and easily
view the computer screen. Students do not need to move to access the computer, they are part of
the students' regular workspace. This proximity allows the teacher to be sure that students can
quickly turn to the Internet as a part of the classroom instruction, or see close-up any images or
text on the teachers' classroom intranet that are pertinent to the lesson. The pods are arranged
around the perimeter of the room; in the center of the room there are tables and chairs. While
some students work individually on the computers, the others can gather together with the
teacher for small group instruction.

The overall number of computers and their arrangement into pods means the teachers need only
plan for two different activities, with one group using computers and another completing the
other activity, which might be independent work or small group work in the center of the
classroom, and then the two groups switch. Teachers commented that this is much easier than to
plan for the three to four rotations needed when they have fewer computers. A sixth grade
teacher explained that this eased the amount of instructional planning and juggling than had
previously been necessary when teachers arranged computers as stations through which the
students rotated:

> When we had eight it was more of a turn kind of thing….So with sixteen---I mean its
> theirs. It's like having a pencil in your hand or a book at your desk; it's just anytime you
> need it, it's there."

Another sixth grade teacher commented, "Technology is no longer a center you go to. It really
became a central part of the classroom."

In using the CCC program, teachers are able to differentiate re-mediation for each child. Each
child receives additional help on her/his own deficiencies, identified through a CCC
administered diagnostic test, without hindering the progress of other students. A sixth grade math
and science teacher explained,

> CCC is geared towards that child at whatever grade level they are at, so if a child is
> working at third grade level they are getting third grade problems that will help build
> their skills and support them in the regular classroom. And again, I couldn't do that. I

couldn't have this child with one activity at third grade level and 29 other students at other stages.

The CCC program also allows students to work independently of teachers' help, and to progress at their own pace. A sixth grade math teacher explained, "…If they see that I am working with someone else, there is a little question mark [in CCC], and they can click on the question mark and a little tutorial will come and guide them through the problem." With half the class working independently on CCC, teachers have more flexibility to work with the other half of the students either individually or in a small group. Another sixth grade math teacher commented, "I am available for [helping] them and when they go [back] to CCC [problems] again they are more able to do it….I can [also] spend more time with the group who is at the learning center in the center of the room." Overall, the CCC program gives the teacher helpful information for assessing students' progress, supports differentiating instruction and provides students self-paced individualized instruction. She concluded, "I really feel like I'm meeting their needs and technology is helping to meet their needs in a way that I never could have as a single person."

The Lemon Grove Middle School teachers also use tool software to enrich and extend the teaching and learning process. Teachers and students use a variety of software, including PowerPoint, word processors, spreadsheets, and e-mail. For example, in a sixth grade math and science class students were preparing an 18-slide presentation of their science project on biomes. In Schultz's sixth grade math class students were using a spreadsheet to learn about formulas in mathematics. Students especially enjoyed the ability to e-mail their friends, and they could also use their e-mails to communicate with their teachers about homework. One student enthusiastically commented, "You can send a project to your teacher through e-mail."

In addition, to instructional uses teachers also create their own curriculum. A sixth grade humanities teacher stated, "using a web site has allowed me to put anything I create, to link it in, and I've got it in the future." Several other teachers followed his example, and the LemonLINK project made plans to offer training on how to start a class intranet, as they referred to it. The students use teacher-made intranet Web sites allow teachers the capability to create their own curricula and present it as a Web page. For example, a teacher might organize a group of Internet sites, add instructions that guide students through them, explain assignments, and post daily agendas. In this way, students stick to pertinent, teacher approved sites as they proceed somewhat independently through material. Since the teacher does not have to act as a monitor, s/he may work on other assignments with a small group in the center area of the classroom. The district uses Internet filtering software to keep students away from inappropriate sites.

Student Practices and Outcomes

The tool software students used in class and the way state curriculum standards –based assignments employ ICT allowed students to demonstrate to their teachers that they not only fulfilled the assignment requirements but that they acquired new skills. Students were very adept with their technology skills; they not only learned the programs but also gained a familiarity with technology that allowed them to quickly pick up new programs. Teachers sometimes assigned projects that could capitalize on the Internet and software tools. For these, students often were assigned to work in groups, where they divided up tasks and had to collaborate in order to be

successful. Many projects involved a research component, which required students apply information skills successfully. The software-based products also allowed students to easily edit their work, which one teacher indicated was more often done now than previously with paper and pencil products.

At this school the CCC drill and practice software is used to diagnose students' mastery of appropriate grade level skills in reading and math. When students first log in to CCC, they answer a series of questions that diagnoses their capabilities in the topics, or strands, that the teacher has chosen. This provides, as a three-digit number, a baseline score for the student; the first digit is the grade level, the decimals represent months of progress in that grade level. For example, in the middle of the school year a 6th grade student whose reading level was 5.50 would be considered a full grade level below where he or she should be. At Lemon Grove Middle School students typically practiced on CCC three times per week, for 15 minutes per session; at any time the teacher could request a report to review the student's level and see if they'd made progress. Students' scores increase when they answer an overall number of questions correctly, and also when they answer correctly a certain percentage of questions on the topics keyed to that grade level in the strand areas selected by the teacher. The program notifies the students when they have progressed to the next higher level.

Teachers and administrators provided us CCC printouts that demonstrated the progress the majority of students were making in their reading and math skills. Descriptions of students raising their scores one to two grade levels were not uncommon. In other cases, the gains were smaller or the students simply progressed in accordance with their grade level status. The feedback from this drill and practice software not only notifies teachers as to students' progress, it also motivates students to reach the standard of age-appropriate skills in math and reading.

The teachers also had to be vigilant for students' thwarting the potential of the CCC program to provide practice and assessment about their knowledge. Some teachers reported that during math, occasionally they would have to tell students to put away the computer's on-screen calculator, which was allowed for some problems but was inappropriate for use with other computational problems.

Students who have the district-supported LemonLINK Home Connection can access school intranet sites, Internet resources, all the tool software, and complete CCC practice strands. The Home Connection also allows parents to go to the teacher's web site to obtain students' homework, and the teachers' lesson plans and daily agendas. Lemon Grove parents who selected this home computer connection have a new way to communicate with personnel from their children's district and school. Currently, nearly 300 families of Lemon Grove district students have the Home Connection.

In 2000 the district compared the 1999 and 2000 SAT9 reading and math test scores of sixth grade students who had twelve or more hours of documented computer use focused on structured reading and math skills development applications with those who had a lesser number of hours of use. The data below do show the positive impact of this particular type of ICT upon student achievement performance, as measured by the SAT9 standardized test (see Table 1).

Table 1
Comparison of percentile point gain on SAT 9 mean scores for participating and non-participating students.

	Percentile point gain on SAT 9 reading subtests	Percentile point gain on SAT 9 math subtests
LemonLINK participants	5	19
Non participants	2	11

Lessons for the Future

Noteworthy Outcomes

Within three years one hundred percent of the school's teachers completed the professional development and the school's classrooms were completely outfitted. This accelerated participation in the LemonLINK program was the result of a commitment by the school's leaders and staff.

The professional development and technical support offered by the district was very highly regarded. The district technology leaders worked hard to provide responsive services to teachers so they could focus on instructional design.

The school district was committed to connecting their entire community through technology. In additional to serving as an ISP and providing network services, the district has worked to provide computers and low cost connections to students' homes.

The entire LemonLINK project was focused on student learning. The school has realized a rise in its state test scores as well as teacher's' noting other positive outcomes.

Added Value from Technology

Each of the two major types of software in the school added value to the teaching and learning process. The drill and practice software allowed students to work to reach their grade level in reading and math. It also provided teachers with information on students' progress. This proved helpful to teachers in targeting students for extra help. The tool software and Internet connectivity allowed teachers to assign students assignments that required them to demonstrate what they learned.

The thin client hardware made it feasible for the district to outfit all classrooms at a 2:1 student to computer ratio. This server-based computing allowed the district to be able to implement very high quality technology support to teachers.

Key Implementation Features

While the LemonLINK federal Technology Challenge Innovation Grant, E-rate funding, and Title I funds provided substantial monetary resources for this district and school, the project directors and administrators have taken care from the start to ensure the district can sustain access to current technology and quality technology support.

The 1997 federal grant award provided $5.2 million to the district over a five-year period and an E-rate grant provided another $1.2 million. These monies allowed the district to invest further in its infrastructure, purchase additional hardware, hire staff for the technology integration coordination, and provide teachers with training, which they are paid to attend. From the outset, the district has established partnerships and purposefully planned its expansion in ways that will allow it to maintain the network and school computers. The school district is its own Internet service provider, which saves on some recurring costs. In addition, it provides network services to the city for a fee, which helps it to recoup some costs.

The thin client computer station is cheaper than a desktop machine, and its technical support (both maintenance and upgrades) can be done from a centralized location. Currently, the 2000 thin client machines are maintained by one full-time technician, in contrast to the four technicians who support the district's 1800 desktop machines. District Director of Information Services LaGace surmised that, considering both support and hardware costs, the move to thin clients reduced to about a third the cost of putting a computer in a classroom and ensured the district had a sustainable model for technical support. Each year the school board has expanded the district's share of the technology budget so that at the end of the LemonLINK grant, it will have a sustainable hardware, network and technical support system. He also added that centralizing on software titles ensures the district gets the best price possible and allows staff to focus in their professional development programming on depth instead of breadth.

The current district wide level of paid professional development---an initial 120 hours for each teacher plus follow up opportunities---is unlikely to be sustained after the grant money ends. The principal noted, however, that since Lemon Grove Middle School is a Title I school (because of the low income levels of the students' families) it could apply these program funds to pay for further technology professional development to support student achievement.

The grade level teams and the collaboration across these teams and throughout the school also contributed to the sustainability of the ICT innovation. Grade level teams learning together helped to establish a common base of knowledge and got them in the habit of sharing ideas electronically, which was reinforced during the follow-up sessions. At the school, the teachers meet in grade level teams to discuss curriculum and other issues. These team interactions are in addition to bi-monthly staff meetings and occasional "minimum days" when students are released early so teachers and staff can work together. At the staff meeting we observed, the greater portion of the time was spent discussing instructional concerns of the staff; the principal indicated that often the discussion or demonstration focused on technology.

Challenges

This district's model of using thin client to increase the overall number of computers available in classrooms poses some challenges for transferability of this strategy to other districts or schools. A thin client model requires a high-speed network (T1 or greater), servers with the necessary software to run server-based application computing, specific technical expertise to set up the necessary infrastructure, and technicians with skills at least equivalent to Microsoft Network Certification. Director of Information Services LaGace has kept up-to-date in the technical developments in his field and has sought out business partners with whom to innovate on the deployment of this strategy in the district. His assessment is that transferability of this strategy to other districts is possible, but requires careful planning. School districts can hire consultants to help them design the implementation. He acknowledged that after factoring in the upfront costs of hardware and software, infrastructure, training or consulting, and servers, in order for a district to see a cost savings, as compared to going with desktop stations, it would need to deploy about 500 thin clients. This high level of commitment could deter other sites from using the thin client strategy. He added that if schools are simply interested in using thin clients to replace aging desktop machines in labs, they might not have a need level that reaches the threshold where they will see cost savings. Also, because thin client stations cannot accommodate CD-ROMs or diskettes, they may not be suitable as the only type of machines in computer labs.