K-12 2.0

A Complete Guide to **One-to-One** Computing in the K-12 Environment

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"For more than 100 years, Maine has always been in the bottom third of states — in prosperity, income, education, and opportunity for our kids. In my 30 years of working on Maine economic issues, no idea has had as much potential for leapfrogging the other states and putting Maine in a position of national leadership as this one — giving our students portable, Internet-ready computers as a basic tool for learning."

– Former Maine Gov. Angus King, quoted in *One-to-One Computing: A Briefing for the Indiana Educational Technology Council* (Draft), Andrew A. Zucker, Ed.D., April 27, 2006

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Introduction and **Overview**

One-to-one computing facilitates teaching and learning by offering every student independent computing power and Internet access both inside and outside of the classroom, 24/7. In the classroom, individual computer use is integral but not exclusive to teaching and learning (see Exhibit I-1.)

One-to-one computing initiatives have great potential. They can prepare students for the demands of citizenship and employment as we approach a future of ubiquitous computing. They can enhance student learning in the classroom today. They can improve student performance on the tests that serve as the basis of school accountability under state law and No Child Left Behind.

Research and evaluation suggests all of this is possible. But one-to-one computing initiatives will meet these expectations only with leadership and planning. They will only achieve their potential if attention is paid to gaining broad support. They will only grow if planning is focused on staff selection and support in the initial sites. They will only improve student learning if teachers can integrate them into teaching. They will only enhance teaching if reinforced with solid professional development. These improvements can only be sustained and extended if one-to-one programs have adequate financing.

This guide has been developed to help educators think their way through one-to-one computing initiatives. It is organized as a collection of materials more than just an essay. Each section summarizes what we have learned about the challenge of developing, implementing and sustaining one-to-one programs; provides exhibits with information straight from the experts; and offers resources for deeper inquiry. It doesn't have all the answers, but it does offer a big picture and direction on where to learn more.

Section One:
Educating the Millennials on the Cusp of Ubiquitous Computing suggests the policy rationale for the implementation of one-to-one computing initiatives. The ability to use computers is becoming fundamental to employment, citizenship and daily life — and will only become more so. Public education has created the basic infrastructure for launching one-to-one initiatives: Almost every public school classroom is wired. Overall, student-to-computer ratios are moving well along the technology adoption curve. Exhibits are drawn from the U.S. Census Bureau, the Bureau of Labor Statistics, *Education Week*'s *Technology Counts* report, the Center for Digital Education and other private research.

Section Two:
Scaling Up Improvements in Student Performance through One-to-One Computing discusses the results of recent program evaluations. Research has proved the positive role of one-to-one computing on student learning, but in scaling up to serve large numbers of students, one-to-one initiatives have encountered the same difficulties as every other school improvement strategy. Still, there are promising results of student success at scale on the tests states employ for school accountability. Exhibits are drawn from RAND's experience with a broad range of school reforms, and academic evaluations of one-to-one initiatives published since 2005.

ONE-TO-ONE COMPUTING SIMPLY MEANS **"ANYTIME, ANYWHERE TECHNOLOGY FOR EVERY STUDENT."**

K-12 ONE-TO-ONE COMPUTING HANDBOOK, CENTER FOR DIGITAL EDUCATION, 2005

Section Three:
One-to-One Success Depends on Teacher Support and Support for Teaching discusses three crucial points. First, the roll-out of one-to-one computing depends on success in the pilot schools, and that places a premium on teachers who believe in the initiative. Second, if teachers are not given adequate support they will not implement one-to-one computing in ways best calculated to obtain the outcomes known to be possible. Third, one-to-one classrooms differ from those with few or no computers. Changes in teaching practice — including classroom management — lead to improved student performance. Exhibits are drawn from the National Center for Education Statistics, research on one-to-one initiatives published since 2005, and teachers' direct experience.

Section Four:
Investment Planning for One-to-One Initiatives provides guidance on budgeting for one-to-one initiatives and potential funding streams. The section offers insights into the selection of one-to-one computing devices. A framework for the analysis of hardware options is provided. Exhibits are drawn from Microsoft, the U.S. Department of Education and the Consortium on School Networking.

Section Five:
Blue Ribbon Deployments features successful and replicable one-to-one deployments from across the nation.

Exhibit I-1
One-to-One Computing Defined

From *What is a One-to-One Learning Environment,* Freedom to Learn Program, 2005

In a one-to-one wireless teaching and learning environment, each participating student is provided access to a wireless laptop (or approved alternative computing device) on a direct and continuous basis throughout the school day, and beyond, if possible.... It is the intent of one-to-one programs to empower students with "anytime and anywhere" learning....

To be effective, one-to-one teaching and learning must attend to a structured process of change that will transform learning from teacher-centered to student-centered. Environmental and cultural readiness, advanced planning, teacher and staff preparation, professional learning and evaluation are strategic elements of a one-to-one program. In addition to providing each student with direct, consistent access to a laptop, successful one-to-one programs allow for:

- *Each student to access homework assignments and school information online, anywhere he or she can connect to the Internet.*
- *Each student to research topics online, download coursework, check e-mail, work in teams with other students, submit assignments online and apply critical thinking skills.*
- *Students to take charge of his/her own learning through experiential and virtual project and problem-based, multi-disciplinary activities in "just in time" formats.*
- *Parents/caregivers to communicate with their children's teachers and view daily classroom work, homework and student achievement to help ensure progress and academic growth.*

- *Each teacher to interact one-on-one with students and parents/caregivers, to keep apprised of each student's progress through online assessment tools, to integrate online content and learning resources with curriculum and instruction, and to expand learning beyond the walls of the classroom.*

- *Each teacher to determine the best classroom management and configuration for optimal teaching and learning for all students. This will include students working in small groups, virtual experiences, as well as individualized and differentiated student approaches in locations that optimize learning.*

Resources Introducing **One-to-One** Computing

What is a One-to-One Learning Environment, Freedom to Learn Program, www.ftlwireless.org/upload_3/What is one-to-one (8).pdf, 2005

One-to-One Computing: A Briefing for the Indiana Educational Technology Council (Draft), Andrew A. Zucker, Ed.D., April 27, 2006

Teaching, Learning, and One-to-One Computing, Talbot Bielefeldt, National Educational Computing Conference, San Diego, July 6, 2006, International Society for Technology in Education, <center.uoregon.edu/ISTE/uploads/NECC2006/KEY_19530803/Bielefeldt_UbiCompNECC2006.pdf>

K-12 One-to-One Computing Handbook, Center for Digital Education, January 2005

Taking K-12 1.0 to the Next Level

In 2005, the Center for Digital Education produced for Gateway the *K-12 One-to-One Computing Handbook*. The handbook, aimed at superintendents, administrators, educators, parents and others interested in understanding the strategy for making one-to-one computing available in K-12 education, served as a foundation to prepare decision-makers for planning, funding and implementing one-to-one computing programs. More than 5,000 copies of the handbook were printed, and more than 1,500 people downloaded the handbook online. This handbook, *K-12 2.0: A Complete Guide to One-to-One Computing in the K-12 Environment*, takes the 2005 handbook to the next level, and features results and analyses of successful and replicable one-to-one computing deployments.

The 2005 *K-12 One-to-One Computing Handbook* is available for download at http://www.centerdigitaled.com/publications.php?pub_id=25. You can request a hard copy by contacting Jeana Graham at 916-932-1406.

Section **One**

Educating the Millennials on the Cusp of Ubiquitous Computing

For the "Millennials," a term used to describe the generation born in the 1980s and 1990s, cell phones, text messages and instant messages are their chosen communication methods. Computer gaming has evolved from casual entertainment to a social event, complete with national and international competitions.... Schools and districts have slowly added technology with one to-one computing initiatives, and a few have even integrated technology into curriculum and teaching methods.

Teaching the Millennials, Center for Digital Education, March 2007

Today, many Americans are no more likely to leave home without their laptop computers than they are to walk out the door without their shoes.

As a result of higher sales and manufacturing improvements and global production, the price of personal computing devices has dropped to a few hundred dollars (see Exhibit 1-1). Dense wireless communications networks cover the nation and the world. Most American households have computers and Internet access (see Exhibit 1-2). "Ubiquitous" (see Exhibit 1-3) access to vast computing power via the Internet is literally well within sight.

Anyone watching young adults and working professionals on their daily commutes will find it especially hard to miss the extent to which individuals are connected to their laptops. Personal computers have become essential for their productivity, communications, research, entertainment and personal organization — anywhere, any time, now. Computer ownership and skills are now de facto requirements for survival in college (see Exhibit 1-4). When the habits of young people with lots of leisure time (see Exhibit 1-5) and older workers with very little (see Exhibit 1-6) converge, it is reason to believe society has reached a tipping point.

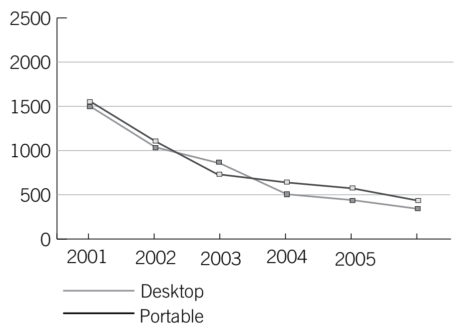
The implications of these facts? Long before a child entering first grade in 2007 graduates high school in 2019, it's a very safe bet that some level of unassisted, individual computer use will be required of most Americans. Moreover, they will need competency with basic computing programs simply to carry on with their daily lives.

Society has placed much of the responsibility for preparing children to be responsible citizens, productive members of the economy, and even to become personally fulfilled, on public education. According to the National Academy of Sciences, our expectations have changed over time. In the 1800s, schools were hardly required to pay attention to literacy. In the 1900s the focus was on developing a capacity to follow instructions. Today, we expect public schools to graduate problem-solvers (see Exhibit 1-7).

Student readiness for a world that embeds computer use and computing in everyday social, work and personal activities will depend on the programs school administrators recommend to school boards, school boards put into the classroom, and teachers offer to students throughout the next decade. Society is especially dependent on public education to close the "digital divide" — to prepare economically disadvantaged students for a world that expects individuals to have basic computing skills. It follows that the closer schools can get to individual computer usage, the better they can prepare students for the future.

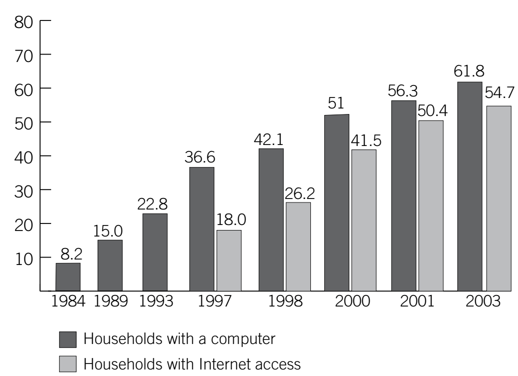
Public education has reached the point at which every school administrator who expects to be in a leadership position over the next decade needs to start thinking strategically about planning for one-to-one computing (see Exhibit 1-8). From the standpoint of basic infrastructure, public schools are catching up with the ubiquitous computing future. There is variation at the local level, but nationally more than 90 percent of classrooms are linked to the Internet, and fewer than four students share one computer (see Exhibit 1-9).

Exhibit 1-1
Computer Prices Over Time



From Avalon PC Price History 2007, http://www.statcan.ca/english/kits/winner/2006/avalon/index.html

Exhibit 1-2
Trends in Computer Ownership and Use at Home Households with a Computer and Internet Access: 1984 to 2003 (in percent)



From *Computer and Internet Use in the United States: 2003,*
U.S. Census Bureau, U.S. Department of Commerce, October 2005

Exhibit 1-3
Ubiquitous Computing Defined

From *What is Ubiquitous Computing?*, Center for Educational Technology, http://www.rcet.org/ubicomp/what.htm

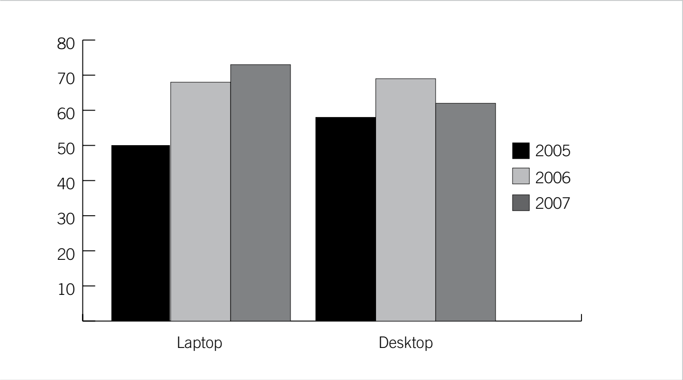
We define ubiquitous computing environments as learning environments in which all students have access to a variety of digital devices and services, including computers connected to the Internet and mobile computing devices, whenever and wherever they need them. Our notion of ubiquitous computing, then, is more focused on many-to-many than one-to-one or one-to-many, and includes the idea of technology being always available but not itself the focus of learning.

Moreover, our definition of ubiquitous computing includes the idea that both teachers and students are active participants in the learning process, who critically analyze information, create new knowledge in a variety of ways (both collaboratively and individually), communicate what they have learned , and choose which tools are appropriate for a particular task.

Exhibit 1-4
Trends in Undergraduate Technology Ownership

From *The ECAR Study of Undergraduate Students and Information Technology, 2007*, Gail Salaway, Judith Borreson Caruso with Mark R. Nelson, Educause Center for Applied Research, 2007.

While nearly all of our respondents own a computer (98.4 percent), laptops continue to gain as the computer of choice... [M]ost respondents (65.5 percent) own a computer two years old or less, well within recommended equipment replacement cycles... [O]ne fifth of respondents (25.0 percent) do make a habit of bringing their laptop to class regularly — weekly or more often...Respondents report spending an average of 18 hours per week actively doing online activities for school, work or reaction...



Percentage of Undergraduate Ownership

Exhibit 1-5
Youth Media Habits 2007

Bridge Ratings Youth Audience Media Use Study 2007, Bridge Ratings, http://www.bridgeratings.com/press_02.14.07-Youth Media Use.htm, Feb. 14, 2007

	TV	Radio	Internet	Magazine	Cell Phones	Newspapers	MP3
'06	2:25	1:45	2:35	:45	1:23	:12	2:05
'05	2:15	1:52	2:25	:46	1:13	:15	1:45
'04	2:44	2:10	2:05	:50	1:02	:17	1:40

Youth 15-24 Years Daily Time Spent with Media (Hrs:Mins)

	TV	Radio	Internet	Magazines	Newspapers	MP3	Cell Phones
'06	21.6%	15.7%	23.1%	.07%	.02%	18.7%	12.4%
'05	21.4%	17.7%	23.0%	.07%	.02%	16.6%	11.6%
'04	25.3%	20.1%	19.3%	.08%	.03%	15.4%	9.6%

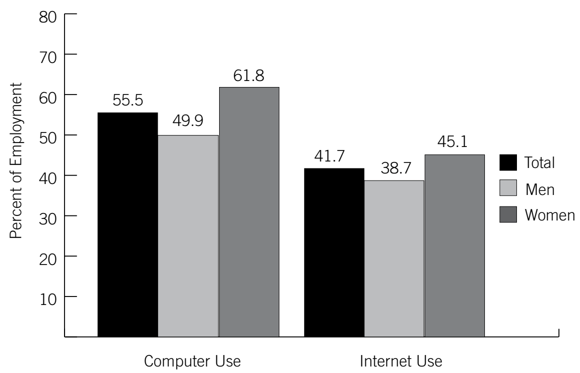
Youth 15-24 Years % of Total Media Time

Media	More	Same	Less
TV	16%	60%	24%
Internet	62%	34%	4%
MP3 Players	78%	19%	3%
Radio	10%	57%	33%
Cell Phones	55%	40%	5%

"Regarding the following media, are you spending More, The Same or Less time with each that you were 6 months ago?"

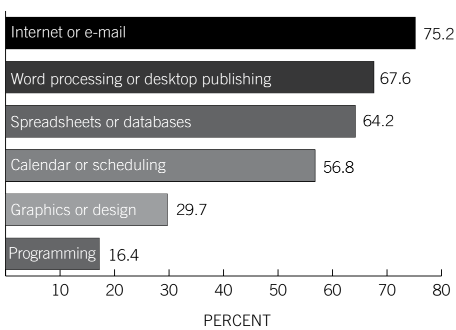
Exhibit 1-6
Computer Use at Work

From "Computer use at work in 2003," *Monthly Labor Review,* Bureau of Labor Statistics, U.S. Department of Labor, http://www.bls.gov/opub/ted/2005/aug/wk1/art03.htm, Aug. 3, 2005



Employed Persons Who Used a Computer or the Internet at Work, October 2003 (percent)

From "Most common uses for computers at work." *Monthly Labor Review,* Bureau of Labor Statistics, U.S. Department of Labor, http://www.bls.gov/opub/ted/2005/aug/wk5/art05.htm, Sept. 2, 2005



Type of Computer Activity at Work, October 2003 (percent of those who used a computer at work)

Exhibit 1-7

Changing Expectations of Public Education

From *How People Learn: Brain, Mind, Experience, and School: Expanded Edition,* John D.Bransford, Ann L.Brown, and Rodney R.Cocking, editors, National Academies Press, 2000

[E]ducational goals for the 21st century are very different from the goals of earlier times...

Consider the goals of schooling in the early 1800s. Instruction in writing focused on the mechanics of making notation as dictated by the teacher, transforming oral messages into written ones. It was not until the mid to late 1800s that writing began to be taught on a mass level in most European countries, and school children began to be asked to compose their own written texts. Even then, writing instruction was largely aimed at giving children the capacity to closely imitate very simple text forms. It was not until the 1930s that the idea emerged of primary school students expressing themselves in writing...Overall, the definition of functional literacy changed from being able to sign one's name to word decoding to reading for new information...

In the early 1900s, the challenge of providing mass education was seen by many as analogous to mass production in factories. School administrators were eager to make use of the "scientific" organization of factories to structure efficient classrooms. Children were regarded as raw materials to be efficiently processed by technical workers (the teachers) to reach the end product. This approach attempted to sort the raw materials (the children) so that they could be treated somewhat as an assembly line. Teachers were viewed as workers whose job was to carry out directives from their superiors — the efficiency experts of schooling (administrators and researchers).

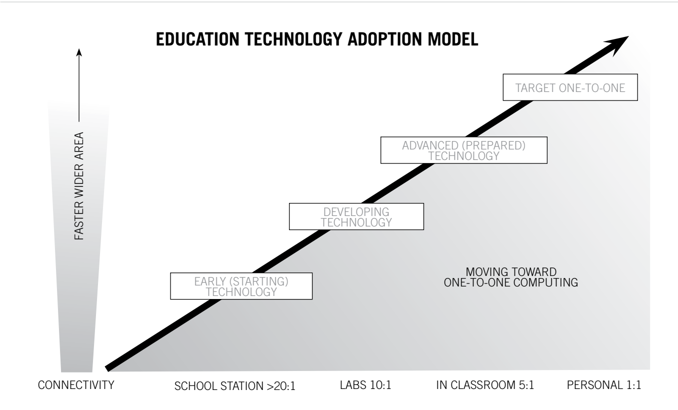
The emulation of factory efficiency fostered the development of standardized tests for measurement of the "product," of clerical work by teachers to keep records of costs and progress (often at the expense of teaching), and of "management" of teaching by central district authorities who had little knowledge of educational practice or philosophy. In short, the factory model affected the design of curriculum, instruction, and assessment in schools.

Today, students need to understand the current state of their knowledge and to build on it, improve it, and make decisions in the face of uncertainty. These two notions of knowledge were identified by John Dewey as "records" of previous cultural accomplishments and engagement in active processes as represented by the phrase "to do." For example, doing mathematics involves solving problems, abstracting, inventing, proving. Doing history involves the construction and evaluation of historical documents. Doing science includes such activities as testing theories through experimentation and observation.... Society envisions graduates of school systems who can identify and solve problems and make contributions to society throughout their lifetime — who display... qualities of "adaptive expertise"... To achieve this vision requires rethinking what is taught, how teachers teach, and how what students learn is assessed...

Exhibit 1-8

K-12 Technology Adoption Model

From *Toward a One-to-One World: Mobile Computing is the Lifestyle of Learning,* Center for Digital Education, sponsored by Intel, 2006

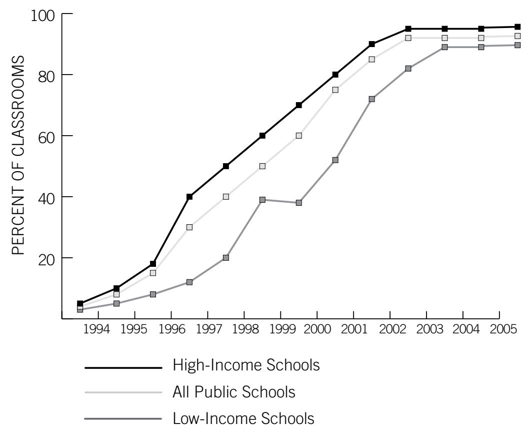


Stages Example RatiosStudents: computer	**Early (Starting) Technology** School Station 20:1	**Developing Technology** Labs 10:1	**Advanced (Prepared) Technology** In Classroom 5:1	**Target One-to-One Computing** Personal 1:1
Leadership	• Create vision • Look at strategies and options • Build a task force	• Plan and set goals • Ensure ongoing communications with stakeholders	• Develop strategic technology plan and implementation plan	• Plan implemented • Easy access to information and resources • Policy created
Funding	• Disparate funding sources — not focused specifically on technology	• Limited availability • Competing demands	• Funding sources focused on technology	• Seek underwriting • Creative sources
Infrastructure and Architecture	• Basic school administration/ computerization • Limited network	• IT Learning • Labs connected	• IT-enhanced Learning • All classrooms connected with teacher's computer • Few students connected	• Provides anytime, anywhere eLearning • Each student has a computer • Policy in place for security and technical support • Consistent access at homeand school
Curriculum Solutions	• Textbook only • Evaluate textbooks	• Textbook/Internet (some Web resources) • Introduce courseware	• Textbook/Internet Courseware • Re-allocate textbook budget to courseware licenses	• Courseware/Internet/ Textbook • Courseware for curriculum; modern apps for alerts and administration • Use eTextbooks • Rich digital content necessary for individualized learning
Professional Development	• Occasional individual training, usually offsite	• Provide training according to initiative plans • Provide basic computer skills training (Microsoft Office, etc.)	• Train IT team • Teachers receive computers well in advance of one-to-one • Base instructional competency on instructional goals	• Ongoing professional development for teachers, staff and administrators • Results in increased instructional proficiency • Full instructional integration • Enables systemic change
Resources and Results	• Program created in a vacuum, not looking at other sources	• Research other one-to-one programs	• Model policy, funding structures, and infrastructure on other successful programs	• Evaluate and demonstrate successes • Data-driven decisions • Become model program

Exhibit 1-9

Student Access to Computers and the Internet

From "A Digital Decade: Technology Counts looks back, and ahead, after 10 eventful years," *Technology Counts 2007: A Digital Decade, Education Week,* March 29, 2007



Internet Access in Schools

From "Technology Leaders: Grading the States" *Technology Counts 2007: A Digital Decade, Education Week,* March 29, 2007

	Students/ instructional computer	Students/ connected instructional computer
National	3.8	3.7
South Dakota (top)	2.0	1.9
Maine	2.1	1.9
Pennsylvania	3.4	3.2
Texas	3.5	3.4
Georgia	3.8	3.7
Michigan	4.1	3.8
California (bottom)	5.1	5.0

Home Computer Access and Internet Use, Child Trends DataBank, www.childtrendsdatabank.org, 2005

Computer and Internet Use at Work In 2003, Bureau of Labor Statistics, Department of Labor, Aug. 2, 2005

Resources for K-12 Education in an **Age of Ubiquity**

"Computer Use at Work in 2003," *Monthly Labor Review,* Bureau of Labor Statistics, U.S. Department of Labor, http://www.bls.gov/opub/ted/2005/aug/wk1/art03.htm, Aug. 3, 2005

"Most Common Uses for Computers at Work," *Monthly Labor Review,* Bureau of Labor Statistics, U.S. Department of Labor, http://www.bls.gov/opub/ted/2005/aug/wk5/art05.htm, Sept. 2, 2005

"Executive Summary," *The ECAR Study of Undergraduate Students and Information Technology, 2007,* Gail Salaway, Judith Borreson Caruso with Mark R. Nelson, Educause Center for Applied Research, 2007.

Computer and Internet Use in the United States: 2003, U.S. Census Bureau, U.S. Department of Commerce, October 2005

Avalon PC Price History 2007, http://www.statcan.ca/english/kits/winner/2006/avalon/index.html

Bridge Ratings Youth Audience Media Use Study 2007, Bridge Ratings, http://www.bridgeratings.com/press_02.14.07-Youth Media Use.htm, February 14, 2007

A Retrospective on Twenty Years of Education Technology Policy, Katie McMillan Culp, Margaret Honey, & Ellen Mandinach, Center for Children and Technology, Education Development Center for the Office of Educational Technology U.S. Department of Education, October 2003

TurningPoint.edu: The Next National Turning Point in Education, Center for Digital Education, 2007

Technology Counts 2007: A Digital Decade, Education Week, March 29, 2007

"Chapter 7: Libraries and Educational Technology," *Digest of Education Statistics 2006,* National Center for Education Statistics, U.S. Department of Education, July 2007

Teaching the Millennials, Center for Digital Education, March 2007

Section **Two**

Scaling Up Improvements in Student Performance through One-to-One Computing

What gets measured gets done.

The fundamental argument for one-to-one computing follows from the fact that public education's core function is preparing students for the world they will enter as adults, and that world will be one of ubiquitous computing. Maybe so, but a far more compelling argument in a world managed by adults who remember when personal computers where a luxury, and even earlier times when any kind of computer was a rarity, is that one-to-one computing can improve student performance on the tests schools are accountable for today.

In the years since educators began experiments with one-to-one computing, it has become abundantly clear that students acquire habits of learning that prepare them for the new economy. The second proposition has been harder to prove. When it comes to the holy grail of K-12 accountability today — student performance on tests of performance against standards of what students should know and be able to do — results have been inconclusive, especially on a large scale.

There's reason to believe that's changing, and with it leadership skepticism. Recent analysis at the school, district and state levels suggests that students in one-to-one computing environments perform at a higher level than comparable students without such programs.

What Matters Today is Student Performance

Research confirms what many would consider intuitively self-evident: One-to-one computing initiatives lead students to higher levels of computer use, increased facility in the employment of computer programs, and greater comfort with the work routines of today's economy (see Exhibit 2-2). It also suggests broader educational payoffs in participation and attitudes (see Exhibit 2-3.)

No educator argues against these long-term benefits. But the immediate challenge facing most public schools is accountability for student performance against state standards in literacy, math and science. The measure of merit in state accountability regimes is a school's average student performance. Federal criteria under No Child Left Behind involve the percentage of students demonstrating proficiency, disaggregated by subgroup. Either way, students' test scores drive school priorities, not measures of their familiarity with tomorrow's workplace.

Those in charge of public education at the state, district and school levels give priority to programs with real promise of raising student achievement, and especially the achievement of students and student subgroups having the greatest difficulty demonstrating proficiency. In their efforts to meet accountability requirements, they are more inclined to devote new discretionary funding, reallocate existing discretionary resources, direct specific funding streams, and seek grants for "what works." Interest in one-to-one computing will be commensurate with evidence that the programs improve student test scores.

"WHY MEASURE PERFORMANCE? **DIFFERENT PURPOSES REQUIRE DIFFERENT MEASURES**,"

ROBERT D. BEHN, *PUBLIC ADMINISTRATION REVIEW,* 2003

School Improvement Programs

It is worth pointing out that those engaged in the development, implementation and support of one-to-one computing have had the same difficulties demonstrating increased student performance at scale, as their counterparts in every other approach to school improvement.

For all school improvement strategies, research of the 1980s evolved into small-scale demonstrations that suggested routines could be developed into programs to improve student learning. The early 1990s saw sufficient success measured by improvements in student performance to justify further investment and pilot programs in real schools. In the early 2000s the pilots offered enough evidence of increased student performance to attract interest and capital in scaling these programs up to reach more schools across districts and states.

Evaluation of the Harvest Park Middle School in Pleasanton, Calif., where students could choose one-to-one computing or a traditional classroom environment, demonstrates the former's potential to enhance student performance (see Exhibit 2-4). Statistical analysis indicated educationally significant improvements measured by cumulative grade point average, end-of-course grades in English and math, district-wide writing assessments, norm referenced and state standardized tests.

Promise of Results at Scale

Like every other school improvement concept competing for educators' attention, one-to-one computing programs and their providers have been stressed by the move to scale. When large numbers of schools with one-to-one computing programs have been matched with similar schools using traditional methods, outcomes have not been clear-cut.

Schools are not machines, and school improvement programs are not products. It takes more than delivering hardware, software and instructions to a school's loading dock to obtain increases in student performance. After decades of evaluation researchers know one thing: To have an effect, the implementation of school improvement programs, including one-to-one computing initiatives, must both approximate what happened in the development, demonstration and pilot sites — and adjust for local conditions. This is no small task.

Moreover, even under the best implementations, the typical pattern of school improvement interventions at scale in the first year is a disruption of old teaching and learning patterns and a gradual move to those of the new program (see Exhibit 2-5). A decline in student performance during the first year is entirely possible. The key indicators are teacher commitment and central office support. If teachers buy into the vision offered by program advocates and determine that their efforts have support in the central they will report the belief that their difficulties were justified. Under these conditions, second year performance should begin to climb back, with anecdotal evidence of real student improvement. In subsequent years, always assuming committed staffs and supportive districts, school improvement should be clearly demonstrated in test scores.

The difficulty evaluators face measuring the extent of implementation is one important reason why no program review over the past decade has come close to suggesting that one-to-one computing is a dead-end. Indeed, the bottom-line evaluation is typically "promising." If this is true, the successful schools identified in every study of one-to-one computing point to what is possible with the right approach to implementation.

Maine's experience stands out as a demonstration that one-to-one computing can raise student achievement in core subjects at scale. As part of the Maine Learning Technology Initiative, Maine rolled-out more than 17,000 laptops to seventh graders statewide, and that number has increased to more than 37,000 to date. In October 2007, the Maine Education Policy Research Institute (MEPRI) at the University of Southern Maine released the results of a study, "Maine's Middle School Laptop Program: Creating Better Writers." The study shows that the Maine Learning Technology Initiative has had a clear and significant positive impact on student writing achievement. In fact, twice as many students met "proficiency" standards in writing in the highest-laptop-use group as compared to the lowest-use group (for more of Maine's results, see Exhibit 2-7).

Michigan's Freedom to Learn Program provides the initial indications of a similar future. In rural, urban and suburban schools across the state of Michigan, students are showing a marked improvement in their standardized test scores in reading, writing, science and math achievement through Michigan's Freedom to Learn (FTL) initiative (for full results, see Exhibit 2-6).

The Freedom to Learn program is one of the largest one-to-one initiatives in the nation, and aims to provide every student and teacher access to a wireless notebook PC in a wireless environment. The program was initiated in 2001 by then-Michigan Speaker of the House Rick Johnson and expanded by the Michigan Legislature and Gov. Jennifer Granholm in 2003. As of March 2006, the Freedom to Learn program included 30,000 students and 1,500 teachers in 181 buildings across 100 school districts.

The South Dakota Classroom Connections one-to-one program is part of Gov. Mike Rounds' 2010 Education Initiative. The 2010 Education Initiative stresses the importance of increasing 21st century skills through the use of advanced technology to enhance learning, and includes the implementation of a one-to-one laptop initiative for high school students. In May 2006, 20 school districts were chosen as pilot schools for the project. In March 2007, 21 new school districts were selected to participate in the program, bringing the total number of high school students with laptops to 9,600 in 41 districts across the state (for more on the South Dakota Classroom Connections, see Section Five: Blue Ribbon One-to-One Deployments).

Exhibit 2-1
Leadership Views on the Added Value of Technology

74% PROVIDES TIMELY DATA FOR DECISION MAKING
71% IMPROVES SUPPORT STAFF EFFICIENCY
71% INCREASES ADMINISTRATIVE PRODUCTIVITY
70% IMPROVES COMMUNICATIONS AMONG PARENTS, TEACHERS AND COMMUNITY
68% MOTIVATES STUDENTS
67% PROVIDES STUDENTS WITH IMPORTANT LIFE SKILLS
61% INCREASES TEACHER PRODUCTIVITY
60% ADDRESSES THE NEEDS OF DISABLED STUDENTS
52% HELPS EDUCATORS INDIVIDUALIZE INSTRUCTION
51% PROMOTES ACADEMIC EQUITY
41% HELPS RAISE TEST SCORES

PERCENTAGE OF SCHOOL LEADERS WHO STRONGLY AGREE THAT TECHNOLOGY PROVIDES THESE BENEFITS. *SOURCE: GRUNWALD ASSOCIATES*

Strong Perceived Benefits of Technology in Schools

From *Digital Leadership Divide: Without Visionary Leadership, Disparities in School Technology Budgets Increase,* Consortium on School Networking, 2005

Exhibit 2-2
The Theory of Action for One-to-One Computing

From *Learning with Technology: The Impact of Laptop Use on Student Achievement* by Gulek & Demirtas, 2005

As reported by Rockman et al. (1997, 1998, 200), laptop use not only reinforces the utilization of successful learning strategies but also enables students to transfer the knowledge across disciplines. This is believed to occur because laptop students are involved in (1) highly engaged and focused activities (spending more time on their work and completing large projects); (2) frequently apply active learning strategies; (3) interact with each other about their work; (4) problem solve through project-based activities, which usually involve more critical thinking; and (5) regularly find information, make sense of it, and communicate it. Research provides evidence that students who engage in collaborative work, participating in more project-based learning, have high levels of motivation (Wigfield et al., 1998, Guthre & Wigfield, 2000). When students are motivated, they demonstrate improved achievement (White, 1989; Roth & Paris, 1991; Roderick and Engel, 2001; Haydel & Roeser, 2002; Gulek, 2003), they produce longer and higher quality writing samples (Reeves, 2001; Goldberg , Russel & Cook, 2003; and spend more time doing homework (Parschal, Weinstein &Walberg, 1984); Walberg, 1984, 1994; Walberg & Haertel, 1997). Similarly teachers using a constructivist approach feel more em-

powered and spend less time lecturing (von Glaserfeld, 1995, 1995b), have fewer classroom management problems (Marzano et al., 2003), and have more engaged learners in their classrooms (von Glaserman, 1987; Jonassen 1991; Fosnot, 1996; Marzano et al., 2003). As seen in the evaluations conducted by Rockman et al. (1997, 1998, 2000), many of these outcomes where observed when students were provided with their own laptop...

Exhibit 2-3

Research-Based Benefits of One-to-One Initiatives

Finding	Reported in*	Example
Attendance and discipline rates improve.	Knezek & Christensen, (2005); Light et al. (2002); Zucker & McGhee, (2005)	Discipline referrals in Texas schools participating in a laptop initiative dropped, while referral rates in comparison schools increased. (Knezek & Christensen, 2005)
Students access a broader array of learning resources and experiences (including increased collaboration with others and increased use of technology for learning).	Lane (2003); Light, et al. (2002); Vahey & Crawford (2002); Walker et al. (2000); Zucker & McGhee, (2005)	Increased use of technology for educational use in school and at home; improved scores on writing assessment in the Microsoft/Toshiba Learning Anytime Anywhere Pilot (Walker et al., 2000).
Relationship between teacher and student changes	Bobkoff & Kratcoski, (2004-2005); Honey (2001); Sargent (2003); Light et al. (2002). Owen et al. (2005-2006); Zucker & McGhee, (2005)	Students and teachers report increased frequency and quality of supportive individual and group interactions (Light et al., 2000).
Student attitudes toward school improve.	Lane 2003; Vahey & Crawford, (2002); Swan et al. (2005); Zucker & McGhee, (2005)	Students and teacher survey responses show increased enthusiasm for school work in classes among participants in Palm's Education Pioneers program (Vahey & Crawford, 2002).
Parent attitudes toward school improve.	Rockman (2003); Zucker & McGhee, (2005).	In schools participating in laptop programs, parent involvement and communication increases (Rockman, 2003).
Student achievement increases.	Gulek & Demirtas, (2005); Light et al. (2002); Muir et al. (2004); Swan et al. (2005); Walker et al. (2000).	Schools implementing Maine's laptop initiative for three years had significantly higher test scores than comparison schools in Science, Math, and Visual/Performing arts. (Muir et al., 2004).

*See the reference list for complete citations.

From *Teaching, Learning, and One-to-One Computing,* Talbot Bielefeldt, International Society for Technology in Education National Educational Computing Conference, San Diego, July 6, 2006

Exhibit 2-4

One-to-One in a School: Increased Student Performance in Harvest Park Middle School

From *Learning With Technology: The Impact of Laptop Use on Student Achievement,* James Cengiz Gulek & Hakan Demirtas, 2005

[E]ighth grade students in the 2003-04 school year... went through the program for three consecutive years... Their baseline data was gathered in 2000-01 when they were fifth graders...

2003-04 Cumulative Grade Point Average

Grade	Program Enrollment	
	Laptop	Non-laptop
Eighth	3.23	3.07

2003-2004 End of Course Grades — Eighth Grade

Letter Grade	Laptop	Non-laptop
	English Language Arts	
A	36%	39%
B	54%	40%
C	10%	17%
D	0%	3%
F	0%	1%
	Mathematics	
A	24%	23%
B	36%	29%
C	20%	28%
D	20%	11%
F	0%	9%

2004 Writing Assessment Results — Eighth Grade

Proficiency	Laptop	School	District
Advanced	15%	17%	16%
Solid	76%	66%	68%
Limited	9%	17%	16%
Minimal	0%	2%	2%

2004 Norm Referenced Test — Eighth Grade

	Language	Mathematics
Laptop	89%	83%
Non-laptop	77%	77%

2004 California Standardized Test — Eighth Grade

	Language	Mathematics
Laptop	76%	58%
Non-laptop	56%	49%

The baseline data for... NRT language arts and math, and the district writing test... shows that there is no significant difference in achievement between laptop and non-laptop students prior to enrollment in the program. However, the comparison between the two groups after one year in the program indicate that laptop students *showed significantly higher achievement in NRT language arts and NRT mathematics. (The) Year 3 results significantly favored the laptop students... Cross-sectional analysis comparing the difference in mean scores indicates that laptop students consistently scored higher than non-laptop students in CST English language arts... The comparison of overall GPA scores demonstrated that laptop students obtained higher GPAs throughout their enrollment in the program. The differences were statistically significant in Year 1 and Year 2, but not in Year 3.*

Four separate analyses were conducted for each of the longitudinal math, language and overall GPA scores... Results... indicate that laptop enrollment has a significant effect on mathematics and language scores. Specifically, participation in the laptop program is associated with an average per-student gain of 16 points for mathematics scores and 13 points for language scores obtained from the state-mandated standardized NRTs. Number of years in the program by laptop enrollment interaction results were not significant in both math and language arts results, suggesting that the effectiveness of laptop use on test scores is not influenced by time, once its overall effect is accounted for. Results also indicate that laptop enrollment seems to improve math cumulative GPA and overall cumulative GPA, yielding a 0.40 increase in math cumulative GPA and 0.34 increase in overall GPA...

[T]his study provides evidence that participation in the laptop immersion program had a significant impact on student achievement...

Exhibit 2-5

First Year One-to-One Implementation

From *Evaluation of The Texas Technology Immersion Pilot, First-Year Results,* Texas Center for Educational Research, April 2006

In the first year, almost all middle schools achieved only partial immersion. Middle schools struggled in the initial year to accommodate the complex demands of technology immersion within the existing school environment. As might be expected, no campus reached full immersion. The two middle schools that made greater strides toward immersion than others (substantial immersion) had stronger district and campus leadership and invested more time and resources in professional development.

In general, first-year implementation was affected by a number of school and contextual factors. First, time for planning was insufficient due to grant-related logistical procedures. Furthermore, many middle schools, which were housed in older buildings, encountered problems with outdated infrastructures and technical problems with wireless networks and Internet connectivity. Districts and campuses also had to grapple with myriad policies and practices related to laptop access and use. The greatest barriers to implementation, however, involved people. Teachers were at different stages of readiness for immersion and their receptivity varied. Varying abilities and attitudes, coupled with teachers' perceived pressures to improve students' scores on the TAKS, made many teachers reluctant to try new and untested instructional methods and materials in the first year. Additionally, leadership at both the district and campus levels emerged as a critical factor driving or limiting progress.

Exhibit 2-6

One-to-One in Districts: Increased Student Performance in Michigan

From *Progress and Results of the Program Evaluation,* Leslie Wilson, Freedom to Learn, 2007

The University of Memphis's Center for Research and Educational Policy (CREP) is Freedom to Learn's (FTL) program evaluator. To obtain baseline student achievement data, CREP completed a statewide analysis of FTL students' MEAP scores in the first two years of the program. Although the results were mixed, they surprisingly found a number of instances where FTL students' MEAP achievement significantly surpassed comparable control group students' achievement... CREP predicts that with continuation of the program these results will increase and become even more pronounced...

- *There is early evidence of instances where FTL students are achieving at higher rates than non-FTL students using MEAP as a measure...*

- *In the Eastern Upper Peninsula Intermediate School District (EUPISD), among all FTL middle schools, they found student achievement progress in math and science. In science, MEAP achievement went from 68 percent proficient in 2002-03 to 80 percent in 2003-04. In math, MEAP achievement went from 57 percent in 2002-03 to 67 percent in 2003-04. EUPISD has participated in FTL since 2002-03 (EUPISD 2005).*

- *At Bendle Middle School in Burton, MI, seventh grade MEAP reading proficiency went from 29 percent in 2003-04 to 41 percent in 2004-05. Eighth grade MEAP math went from 31 percent in 2003-04 to 63 percent in 2004-05 (Bendle Schools 2005).*

- *In Bear Lake Schools, fifth graders in 2002 went from 33.3 percent proficient in MEAP writing to 76 percent in 2004 as seventh graders (Bear Lake Schools).*

According to project director, Dr. Steven Ross... the most impressive aspect of the FTL findings was the high level of proficiency in which Michigan students, at all socioeconomic levels, were using state-of-the-art technology to solve meaningful and authentic learning tasks which are essential for today's workforce and economic development.

Exhibit 2-7

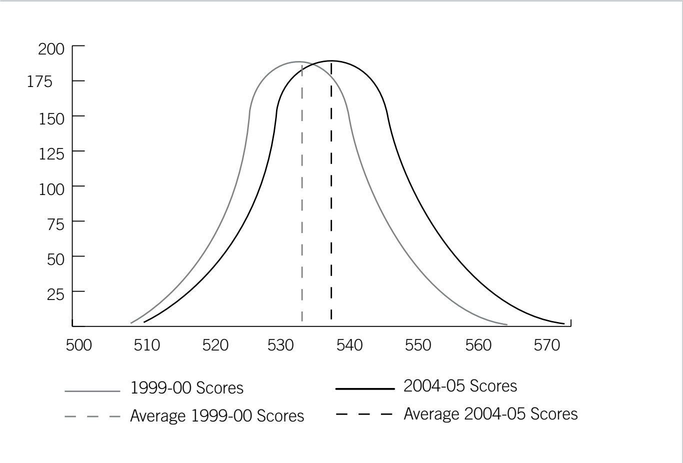
One-to-One in States: Increased Student Performance across Maine

From *Maine's Middle School Laptop Program: Creating Better Writers,* David L. Silvernail and Aaron K. Gritter, Maine Education Policy Research Institute, University of Southern Maine, October 2007

[Eighth] grade MEA (Maine Educational Achievement) writing scores were examined for two time periods; for 2000, a year prior to implementation of the statewide program, and for 2005, five years after the initial implementation of the program. The writing portion of the MEA consists of a writing prompt that is double scored. Scale scores may range from 500 to 580, and a scale score of 540 or above indicates a student has met or surpassed the state established proficiency level in writing. The following graph depicts the... information... as normalized scale scores for the two years.

An average student in 2005 scored better than approximately two-thirds of all students in 2000. Further analysis revealed there was a concomitant improvement in the number of students actually meeting the state writing proficiency standard. In 2000, 29.1 percent of the eighth graders met the writing proficiency standard on the MEA, and in 2005, this had increased to 41.4 percent. Thus, the results indicated writing performance has improved.

[O]ther factors, beyond implementation of the laptop program, may have contributed to improved writing performance over the course of five years (implementing new writing programs in schools, more teacher professional development, etc.), but since these did not occur in all Maine middle schools, and the results are based on the total population of all eighth graders and all Maine middle schools, the results may be attributed, at least in part, to the laptop program.



Normalized Scale Scores for All Students in 2000 and 2005

Resources for One-to-One **Program Evaluation**

Expanding The Reach Of Education Reforms: What Have We Learned About Scaling Up Educational Interventions, Thomas K. Glennan, Jr., Susan J. Bodilly, Jolene Galegher, Kerri A. Kerr, RAND, 2004

Ubiquitous Initiatives (to 2006), Computing Evaluation Consortium, http://ubiqcomputing.org/ubiq_initiatives.html

The Effect of Computers on Student Writing: A Meta-Analysis of Studies from 1992 to 2002, Amie Goldberg, Michael Russell & Abigail Cook, *The Journal of Technology, Learning, and Assessment, Boston College,* February 2003

Learning With Technology: The Impact of Laptop Use on Student Achievement, James Cengiz Gulek and Hakan Demirtas, *The Journal of Technology, Learning, and Assessment,* Boston College, January 2005

A Syntheses of New Research on K-12 Online Learning, Rosina Smith, Tom Clark, Robert I. Blomeyer, Learning Point Associates, November 2005

What Added Value Does a One-to-One Student to Laptop Ratio Bring To Technology-Supported Teaching And Learning? Matt Dunleavy, Sara Dexter, Walter F. Heinecke,Ubiquitous Computing Implementation Research, Jan. 10, 2006

Evaluation Of The Texas Technology Immersion Pilot, First-Year Results, Texas Center for Educational Research, April 2006

Maine's Middle School Laptop Program: Creating Better Writers, David L. Silvernail and Aron K. Gritter, Maine Education Policy Research Institute, University of Southern Maine, October 2007

Helping Practitioners Meet the Goals of No Child Left Behind, Office of Educational Technology, U.S. Department of Education, September 2004

Digital Leadership Divide: Without Visionary Leadership, Disparities in School Technology Budgets Increase, Consortium on School Networking, 2005

"Why measure performance? Different purposes require different measures," Robert D. Behn, *Public Administration Review,* 2003

Section **Three**

One-to-One Success Depends on Teacher Support and Support for Teaching

"It's really not about the laptops. It is about what the one-to-one laptops enable in terms of new ways of teaching and learning... [A]longside the costs of purchasing hardware, the costs of well thought out professional development and management programs must be budgeted for as well. If the teachers and the technology specialists do not have opportunities to learn about and plan for meaningful and well-managed one-to-one uses, it is less likely that the laptop programs' goals will be reached, and the related investments warranted."

– Matt Dunleavy, Sara Dexter, Walter F. Heinecke, *What Added Value Does a One-to-One Student to Laptop Ratio Bring To Technology-Supported Teaching And Learning?*

The printing press changed popular education, not because textbooks could be published in unlimited quantities, but because educators changed teaching practice to take advantage of the new technology. Publishing allowed large quantities of knowledge to be freed from a few libraries and available in every home. In brief, ubiquitous print allowed education to move from tutoring the elite in their homes to teaching the whole public in specialized facilities. It allowed all this, but it happened only because educators evolved from tutors to teachers.

The transition was undoubtedly awkward for many educators. Some embraced the vision of public education; others resisted it; most probably groped their way through the process.

Something similar is underway today. Giving every child a computer will only improve student learning to the extent that teachers integrate the technology into classroom practice, and change that practice to leverage the features of ubiquitous computing environments. Exciting as these capabilities are to most of us, they change teaching, and change is not always easy. Leaving aside the very real fear of the unknown, the one-to-one classroom requires new teaching practices. Unless the new practices can be explained and understood, the inevitable transition will be painful.

Teacher support lies at the center of one-to-one computing success, yet today's teaching force is highly skeptical of computers' contribution to teaching. In 2005, the National Center for Education Statistics published a study of public school teachers' perspectives on computer technology in the classroom (see Exhibit 3-1). Just under half believed that having at least one computer for every four students in their classroom was essential to their teaching. Other research suggests that teachers will be inclined to move back to traditional teaching methods when faced with the prospect of oncoming high-stakes accountability tests (see Exhibit 3-2). Because teachers are not assigned on the basis of either attitude, it's a safe bet that a substantial portion of every school's teaching staff have not embraced the educational implications of a networked world and have not changed their teaching practices accordingly.

Even the staff most committed to one-to-one computing will turn against the program if administrative leaders do not follow through on their promises of material and political support, or if they allow central office directives aimed at the whole system to undercut school specific activities essential to the initiatives success. When conflicts do occur — and they will — the school's principal must be an effective advocate for the program, and be seen as one. But perhaps the most important expression of support is professional development (see Exhibit 3-3).

Success at the first sites is essential if one-to-one computing is to expand across a district or state, Where teachers do not buy into one-to-one computer deployments, implementation will suffer. Teacher attitudes are central to success, and the sources of positive attitudes involve what they and the district bring to the effort.

Consider the downward spiral model of program implementation driven by the negative feedback loop from a bad start. If teachers don't want to use a school improvement program, they will not use it well or avoid it entirely. When implementation falls short of what's needed, student outcomes are not likely to improve, and may well decline. Because program evaluation tends to treat all implementation equally, poor implementations will depress the number of schools with positive outcomes and the likelihood that evaluations will show any significant increase over the control groups' traditional methods of instruction. Poor evaluations do not bode well for the expansion of one-to-one computing, and other teachers will not be eager to join.

The identification and development of appropriate leadership teams at the school level is crucial (see Exhibit 3-4), but no route to program failure is more certain than a top-down directive that a school implement a complex improvement program. If the success of school improvement programs as measured by increases in student performance depends on teacher buy-in, and many teachers at any school are likely to resist the level of implementation required for one-to-one computer programs to have their intended impact, administrators need a realistic assessment of teacher attitudes before they select school sites for initial deployment. The overwhelming majority of teachers at the site selected for initial deployment should express informed, willing support.

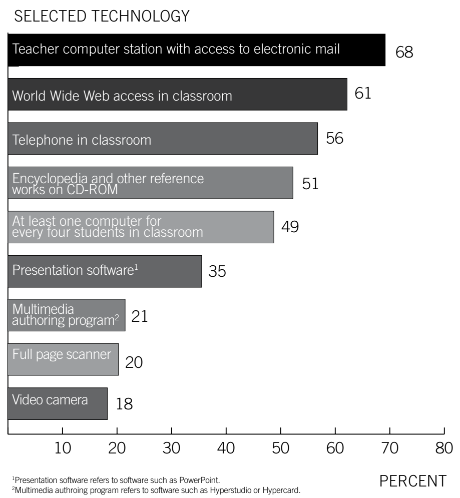
Some effort should be made to gauge the extent of active, open, enthusiastic support within the teaching staff, especially de facto leaders. Teachers with an open mind should be encouraged to stay on because they may become ambassadors to the great numbers of colleagues who don't yet embrace a ubiquitous computing future. Teachers that do not support the initiative should be given an easy exit, and teachers prepared to stay on for reasons other than support for the computing program should be counseled out of the school.

Networked computers allow students vastly expanded access to information, incredible calculating power, the ability to simulate reality, unlimited contact with individuals around the world. In a sense, they even offer some of the advantages of personalized learning once held exclusively by old-time tutors. Even more exciting is how far beyond the old teacher-student relationship one-to-one environments can go — to a place where knowledge passes in both directions (see Exhibit 3-4).

This guide cannot prepare teachers for the teaching and learning environment of one-to-one computing, but it can offer some insights and examples. The one-to-one computing environment offers teachers opportunities to take basic day-to-day classroom activities to much higher levels of effectiveness, including online research, sophisticated drill and practice, and teacher communication with students (see Exhibit 3-5). It also makes entirely new teaching and learning dynamics possible (see Exhibit 3-6). By the same token, some aspects of traditional classroom management are readily transferred to the one-to-one environment (see Exhibit 3-7), while some techniques are entirely new (see Exhibit 3-8).

Exhibit 3-1
Classroom Educators' Views on the Role of Technology in Teaching

From *Computer Technology in the Public School Classroom: Teacher Perspectives,* National Center for Education Statistics, U.S. Department of Education, 2005



Percentages of Teachers who Believed Selected Technologies Were Essential to Their Teaching: 2000-01

Exhibit 3-2
Teachers' Fears

From *The Effects of High-Stakes Accountability on Ubiquitous Computing Initiatives: A Multiple-Case Study,* Walter F. Heinecke, Center for Technology and Teacher Education, Curry School of Education, University of Virginia, April 18, 2006.

A teacher at Lewis commented on the impact of the accountability policy on the technology initiative:

"There are so many important and wonderful things about accountability to the standards, but one of the things that I feel does happen if you don't feel confident that you are a teacher who is being effective, it is harder to throw yourself into learning to apply and use the technology when you are really nervous about … accountability that is focused on this test score. Especially when there has been no assurance that if you throw yourself into this, your test scores are going to zoom up. … But at any rate, that's an effect that I think it has had on technology. It can create a greater tension about technology, because I have to abandon what I know as a teacher and now start using this. Maybe I am going to screw up these kids, or my test scores are going to go down. …For instance, if you are the teacher, right now, in our district, and you are working with English language development students, and our scores have gone down, you did not have enough time in the day to do other things. It is pretty hard for you to say I'm going to devote more time to this, when my butt's on the line, or the district's. There is tension for that. So I think for some teachers that would be an inhibitor." (Teacher, Lewis Middle School)

Exhibit 3-3
Strategy for Teacher Support

From *One-to-One Computing In Support Of Science and Mathematics Education Recommendations for Large-scale Implementations,* Robert Tinker, Alvaro Galvis, and Andrew Zucker, February 2007

Teacher professional development (TPD) can be the largest cost in implementing effective one-to-one computing, so its goals and strategies must be carefully planned in advance. TPD costs can be reduced by concentrating on teaching and avoiding overemphasizing technology. By using well-designed student materials with built-in teacher supports and taking full advantage of local resources, TPD costs can be reduced and resources focused primarily on new content and instructional strategies.

The goal of one-to-one computing necessarily requires the development of strategies that work for all teachers. Therefore, the instructional and TPD strategies used must apply to every teacher, not only the "early adopters," or those with "above average" technical skills. It is often erroneously assumed that the introduction of educational technologies requires teachers to become experts in information technologies—in the use of various software tools, a broad range of applications, and one or more programming languages. While it may be desirable for every teacher to have such skills, it is neither a realistic nor necessary goal.

Similarly, it is often assumed that teachers will create their own technology-enriched student learning materials by authoring lessons or at least knitting lessons together from a wide range of resources. Again, it would be wonderful if every teacher could do this, and it is certainly expected of university faculty, but this is an unrealistic and unnecessary goal for the majority of pre-college teachers.

Exhibit 3-4
Distributed Leadership

From *Leadership Practices that Facilitate Effective Teacher Learning Environments*, Sara Dexter, University of Virginia, Nov. 11, 2006

To achieve the best uses of educational technology in support of learning at a school it is likely its teachers will need opportunities and support for learning (Zong, Pugh, Sheldon & Byers, 2002)... Bransford, Brown and Cocking (1999) synthesize the last 10 years of research on learning and suggest four elements for effective learning environments, which can be applied to teachers' learning environments. They should be learner-centered, taking individual learner needs into account; knowledge-centered, directed toward developing deep understanding; assessment-centered, using assessment mechanisms to guide the learner; and community-centered, allowing for social processing of information. [T]eachers need formal opportunities to learn that are appropriate for their starting point yet in-depth on what effective technology uses look like in their subject area... they should receive feedback on their integration efforts and... informal learning and support from a community of peers...

There is increasing interest in how groups of individuals might work together in a school to lead a common goal... Spillane and colleagues (Spillane, Halverson & Diamond 2001, 2004; Spillane, 2005; Spillane & Orlina, 2005) have used the phrase "distributed leadership," to capture how leadership consists of the practices of multiple leaders, and emphasizes how this takes place in "the interactions between leaders, followers, and their situation" (Spillane, 2005, p. 144). [D]istributed leadership allows for the technology infrastructure itself to become a part of the conceptual model of technology leadership and thus recognizes explicitly how the programmatic goals for technology will contribute to the definition and construction of the technology leadership practices. From this approach the emphasis of study are the tools, structures, and routines — or artifacts (Halverson, 2003, 2005; Halverson & Clifford, 2003) — of leadership practices that are created through various procedures and policies in order to accomplish programs or tasks.

[S]chools with an instruction-oriented vision for their laptop programs create a more compelling setting for technology integration through strong technology leadership practices. Artifacts such as technology vision influence the makeup of the community that comprises the teachers' learning environments. It also influences the number and job roles of the technology staff members, another artifact of technology leadership practice, and these staff in turn have an impact on the depth of knowledge teachers are to develop regarding technology and its integration and the support they have in this work. Artifacts such as the alignment of Internet and computer-based resources with the curriculum, and membership on the technology committees are additional representations of the technology leadership practices at a school...

Considering school technology leadership as a school characteristic and applying a distributed leadership model to technology leadership practices emphasizes the significant influence of the leaders' purpose for the technology. [W]ithout a strong instructional focus technology implementations can get reduced to a struggle to keep up adequate access and technical support. The technology's purpose symbolizes the leaders' ideas about how technology can support the nature of learning. The technology's purpose influences what artifacts, structures, routines and tools the technology leaders put into place, which further represents in a more *detailed way their conceptions of the appropriate role and involvement of technology coordinators, teachers, and students, and the value of any of these groups as technology leaders. These elements then influence the follower's actions, which in turn influences and shapes the situation in which the technology leaders act. [L]eaders must have a vision for technology but provide nuance to that by illustrating the recursive effect between the situation and the what, how, and why of technology leadership practices.*

Exhibit 3-5
One-to-One Learning Environments

From *How People Learn: Brain, Mind, Experience, and School: Expanded Edition,* John D.Bransford, Ann L.Brown, and Rodney R.Cocking, editors National Academies Press, 2000

What is now known about learning provides important guidelines for uses of technology that can help students and teachers develop the competencies needed for the 21st century. The new technologies provide opportunities for creating learning environments that extend the possibilities of "old" — but still useful — technologies — books; blackboards; and linear, one-way communication media, such as radio and television shows — as well as offering new possibilities. Technologies do not guarantee effective learning, however. Inappropriate uses of technology can hinder learning — for example, if students spend most of their time picking fonts and colors for multimedia reports instead of planning, writing, and revising their ideas. And everyone knows how much time students can waste surfing the Internet. Yet many aspects of technology make it easier to create environments that fit the principles of learning discussed throughout this volume.

Because many new technologies are interactive, it is now easier to create environments in which students can learn by doing, receive feedback, and continually refine their understanding and build new knowledge. The new technologies can also help people visualize difficult-to-understand concepts, such as differentiating heat from temperature. Students can work with visualization and modeling software that is similar to the tools used in nonschool environments, increasing their understanding and the likelihood of transfer from school to nonschool settings. These technologies also provide access to a vast array of information, including digital libraries, data for analysis, and other people who provide information, feedback, and inspiration. They can enhance the learning of teachers and administrators, as well as that of students, and increase connections between schools and the communities, including homes.

Exhibit 3-6
How One-to-One Improves Teaching

From *What Added Value Does a One-to-One Student to Laptop Ratio Bring To Technology-Supported Teaching And Learning?* by Matt Dunleavy, Sara Dexter, Walter F. Heinecke, 2007

[W]e use the phrase 'added value' to discuss what networked laptops contribute to teaching and learning; by this we mean the capabilities provided by one-to-one student to networked laptop ratio that otherwise would not be possible…

The most frequent use by teachers and students of the laptops... was online research used in conjunction with productivity tools…

One example comes from an eighth grade language arts class... Networked laptops allowed for the students to access information and to process it in an organized fashion... Because it was a one-to-one environment the students were able to execute the actions in real time and ask any questions they had immediately. This supported the teacher in spending minimal time on helping them learn the basic, discrete skills of guided searching, selecting, and cutting and pasting pieces of data and instead emphasize to them the point of their search, which was the more complex, higher order thinking activity of autonomous research and the production of a research paper.

The second most frequent laptop use... was drill and practice exercises... [T]he majority of the observations recorded high level, individualized exercises that were learner-, assessment-, knowledge-, and community-centered.

[A] sixth grade social studies teachers used Discourse to create a scaffolded series of tests that enabled the students to practice and demonstrate their knowledge of Indian culture until mastery had been achieved. Discourse is Internet-based software that allows teachers to monitor the responses students make on their laptops keystroke by keystroke... [U]sed in conjunction with a one-to-one student to networked laptop ratio ... it allowed the teacher to view the answers of the students in real-time so that he could intervene with a written prompt, correction, or encouragement that only that individual students could view. The student could then revise immediately before the test was complete.

The third most frequent use... was online environments, such as classroom Web sites and video to disseminate information, facilitate communication, and enhance instruction...

[I]n an observed seventh grade science class...[t]he teacher began... by instructing the students to open their tablet-style laptops and to retrieve the day's agenda from the class Web site. The Web site contained the class calendar... and numerous other resources. The day's agenda provided the goals of the lesson, the instructions for getting started, and a list of the programs that would be needed to accomplish the task...

The one-to-one... ratio... provided added value in two ways. First, the teacher used the Web site to communicate what she wanted the students to know, what she wanted the students to complete, and what she wanted the students to be able to do by the end of the lesson as well as by the end of the year... Because students were able to access these e-communications as they worked through the assignment they could reference and proceed with them at their own pace, and follow links to additional information or directions more seamlessly. Second, because these class materials are online, students and parents alike can access the class information outside of class using the laptops. This supports student autonomy and independence as well as parental awareness.

Exhibit 3-7
Teaching and Learning in Math and Science

From *A Study of One-to-One Computer Use in Mathematics and Science Instruction at the Secondary Level in Henrico County Public Schools,* Andrew A. Zucker and Raymond McGhee, SRI International, February 2005

Science students did "virtual dissections" on the subscription Web site Froguts.com, took virtual field trips, went on WebQuests... wrote up laboratory experiments using a word processor, and created their own Web pages — to name just a few of their laptop activities. In a seventh-grade life science classroom, for example, students presented [movies] they had created about specific topics in the curriculum, such as recycling. Later, during the same class, the teacher asked students each to complete an online quiz from Beyond Books. This single classroom period illustrates how students used the laptops both for drill and practice and to develop their own, unique documents.

Most of the science teachers who were interviewed and observed asked students to use laptops for many purposes, including cultivating the skills necessary for scientific inquiry: generating research questions; formulating hypotheses or predictions; developing models to describe or explain a phenomenon; and collecting, displaying, and analyzing data.

Mathematics students in the four schools used Larson's Algebra, The Geometer's Sketchpad, ExploreMath, and other software licensed by the school system. Students reported that they made use of spreadsheets, drawing programs (to create geometric figures), and a variety of online Web sites that allow teachers to create tests and review activities that their students can access online. In a sixth-grade accelerated mathematics class, for example, the teacher had students solve a complex problem. Students worked independently to start, the teacher then led a discussion about the problem, and finally the students worked in pairs to solve it.

As another example, a first-year mathematics teacher told a visitor that she would have her sixth-graders do an online review of a geometry unit in a format called Rags to Riches, in which the students could win a fictional $1 million prize by answering a series of questions correctly. "They will love it," she predicted — and she was right. Students, many of whom had failed their fifth-grade SOL tests, were on task, working individually answering questions about geometry throughout the allotted time. The teacher believed that the immediate feedback from the computer was helpful in maintaining students' attention, and she said of the computer initiative, "It has helped a lot of kids who want to succeed."

Exhibit 3-8
New Teaching Opportunities Offered by the Ubiquitous Computing Environment

From "Interactions in a Ubiquitous Computing Environment: The Implications of Discourse for Children's Conceptualizations and Representations," Annette Kratcoski and Karyn Bobkoff Katz, *Journal of the Research Institute for Educational Technology,* 2006

In the ubiquitous computing classroom... The computer appeared to be an active (rather than passive use of technology) participant in the learning context. The child, the teacher and the computer form a discourse "triad" making up the learning context. The work of the computer was to provide the content of the lesson, stimulate the *child's learning and thinking about the content, while the teacher discourse served to facilitate the smooth use of the "learning partner" (Katz & Kratcoski, 2003).*

Two patterns of scaffolding appear to create different learning contexts for children within the ubiquitous classroom contexts...

In the whole class lessons format, the lesson is conducted in a teacher-led pattern. The group of students are gathered, all focused on the content presented by the teacher and the technology. The whole group is shown the lesson content with the use of passive technology, the display screen. [T]he teacher used the presentation system to project student generated products for the entire class to see. [I]n this context, the teacher is providing a rich source of both conceptual and representational support through her use of a range of verbal behaviors... This pattern of verbal support would suggest that with passive use of technology, the teacher supplements the impact of the lesson by utilizing discourse to enrich the content for students...

A contrastive learning context is used when small group or individual work becomes the format of classroom lessons. When children's attention has been drawn to specific technology tools, the goal of the lesson appears to shift from using children's work products to conduct the lesson to the creation of lesson content or the children's working to solve a problem.... In this role, technology can become an active participant in the learning context. Solving problems, creating content, answering questions can all be supported by the technology tools... The teacher's role appears to shift into a "learning facilitator" rather than a "learning guide," while the technology tools begin to assume the "guidance" role...

In the ubiquitous classroom setting, the students used the Internet to explore and conduct research regarding force and motion... The students created numerous digital representations including force and motion animations... as well as claymation movies... Clearly, the technology was used in such a way that it allowed students to experiment with new concepts, processes, and skills in ways that would not otherwise be possible learners as they attain ever higher levels of conceptual understanding. The discourse provided by the teacher no longer was as necessary for the creating of a context for learning, yet the lesson goals were successfully led by the tools of technology.

Exhibit 3-9
Basic Rules of One-to-One Classroom Management

From *One-to-One Computing and Classroom Management,*
Mike Hasley, *21st CenteryConnections,*
http://21centuryconnections.com/node/339

Lesson development... A good lesson plan that keeps the student involved will reduce classroom problems — whether you are using laptops or not. I always had written lesson plans, even after 10 years of teaching. In your lesson plans, spell out exactly what you expect your students to do with their laptop...

Management by Walking Around... If you see a kid off-task because of his or her computer, deal with it appropriately. Make sure you circulate in a way that allows you to see the most in one view... [W]atch for certain tell-tale signs, such as when kids' eyes are more fixated on the screen, or they are typing faster than normal, or their heads remain in a downward position longer than necessary. These may be signs of kids off task.

Pick your battles... If you try to put out every forest fire in the classroom, you won't get anything done. If you see a little goofing off, say students on the wrong Web site but otherwise are doing their work, let them be.

Consistency... Be consistent with rules and how laptops are used. One way to reinforce this is to have VIP (Visual Instruction Plans) in your classroom. These are simply posters with instructions for laptop-use: how to get to your web page; how to get to your virtual share; how to print. Posters should address the most-asked questions. Then all you have to do is, calmly and coolly, point to a poster on the wall...

Use timers… Timers are great for any activity such as quizzes, warm ups, discussions, and more...

Expectations…[T]ell them clearly what you expect, such as no idle surfing, no instant messaging, etc...

Daily sign-off sheets… [A]long with daily expectations, let them know that you expect to see what they completed for the day...

Down time… If students finished the work for the day, or some are done and others are not, let them do their own thing...

Exhibit 3-10
Managing Students in the Engaged Classroom

From *What Added Value Does a One-to-One Student to Laptop Ratio Bring To Technology-Supported Teaching And Learning?* by Matt Dunleavy, Sara Dexter, Walter F. Heinecke, (2006)

While the computers are powerful tools, they can also serve as a competitive or disruptive distraction... [T]he authors observed teachers having to repeatedly instruct the students to close their laptops when not using them for the lesson and to navigate to the appropriate page. They also recorded isolated, but significant examples of teachers unable to successfully manage the one-to-one student to networked laptop ratio. [I]f the teacher does not have strong class management skills, the computers simply add another layer of management complexity that is possibly overwhelming...

Technology specialists and other technology leaders at schools with laptop programs will need opportunities to learn about and plan for the challenges of managing ubiquitous laptops in the K-12 environment. It is critical that the leadership implement policies and routines that allow teachers to focus on the significant tasks of integration, rather than distracting management issues such as charging the laptops' batteries or preventing students from accessing inappropriate Internet sites. Associated with this management might be additional costs for carts, electrical work, insurance policies, and loaner laptops, [software], parent education programs, and school board approval of new policies. This suggests a need for careful "What if?" planning that brainstorms all the things that could go wrong when several hundred adolescents are simultaneously given delicate and expensive machinery that is vulnerable to viruses and other malfunctions.

Resources for **Supporting Teachers**

Computer Technology in the Public School Classroom: Teacher Perspectives, National Center for Education Statistics, U.S. Department of Education, http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2005083, March 2005

Educational Technology in Teacher Education Programs for Initial Licensure, Teacher Perspectives, National Center for Education Statistics, U.S. Department of Education, http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2008040, December 2007

Show Me the Leadership: The Impact of Distributed Technology Leadership Teams' Membership and Practices at Four Laptop Schools, Sara Dexter, University of Virginia, 88th Annual Meeting of the American Educational Research Association, http://edtechcases.info/analysis/tech_leadership.htm, April 11, 2007

Leadership Practices that Facilitate Effective Teacher Learning Environments, Sara Dexter, University of Virginia, Nov. 11, 2006

One-to-One Computing In Support Of Science And Mathematics Education Recommendations For Large-scale Implementations, Robert Tinker, Alvaro Galvis, and Andrew Zucker, February 2007

The Effects of High-Stakes Accountability on Ubiquitous Computing Initiatives: A Multiple-Case Study, Walter F. Heinecke, Center for Technology and Teacher Education, Curry School of Education University of Virginia, edtechcases.info/analysis/ubiqpolicycroscasev6.pdf, April 18, 2006

A Study of One-to-One Computer Use in Mathematics and Science Instruction at the Secondary Level in Henrico County Public Schools, Andrew A. Zucker and Raymond McGhee, SRI International, February 2005

"Interactions in a Ubiquitous Computing Environment: The Implications of Discourse for Children's Conceptualizations and Representations," Annette Kratcoski and Karyn Bobkoff Katz, *Journal of the Research Center for Educational Technology,* Kent State University http://www.rcetj.org/?type=cc&id=17, Spring 2006

Editorial: Developing technology policies for effective classroom practice, Glen Bull, John Park, Michael Searson, Ann Thompson, Punya Mishra, Matthew J. Koehler, and Gerald Knezek, *Contemporary Issues in Technology and Teacher Education,* http://www.citejournal.org/vol7/iss3/editorial/article1.cfm, 2007

Problem Solving in Technology-Rich Environments: A Report From the NAEP Technology-Based Assessment Project, National Center for Education Statistics, U.S. Department of Education, August 2007

Section **Four**

Investment Planning for One-to-One Initiatives

"[S]mart project managers qualify their line-by-line budgets by adding two components: a list of priorities and a contingency plan. The priority list... outlines and ranks the project's goals. This list can be useful in assigning resources to each part of the project and helps you retrench if elements of the project cost more than anticipated. A logical next step, the contingency plan indicates which elements could be curtailed or cut if the budget is threatened."

– Tim Wilson, "Affordable IT: Staying on Budget," *Networking Computing*, http://www.networkcomputing.com/showitem.jhtml?articleID=163702205, June 9, 2005

"Best practices" and worst mistakes in one-to-one initiatives have been translated into "lessons learned" for everyone from the school board member and superintendent, to the principal, classroom teacher, community member and parent. Experience has informed the development of detailed checklists for educators assigned the responsibility for program management, and can help greatly with implementation (see Exhibit 4-1).

The budget *is* policy. A decade or more of experimentation has produced a wealth of "how to" guides relating and reducing the full range of issues surrounding one-to-one initiatives to costs (see Exhibit 4-2). If the ultimate goal of one-to-one computing is a ubiquitous computing environment for every student, the budgetary implications are substantial.

For the one-to-one concept to become embedded in every school, as integral to classroom practice as blackboards were a hundred years ago and whiteboards are today, permanent sources of funding will have to be found. There is no alternative to a finance strategy incorporating both painful reallocations of resources from comfortable routines of teaching and learning, and uncomfortable requests to the taxpayers for additional resources.

Nevertheless, this future isn't here today, and administrators worry about what to do until then. Navigating a way between now and the future is a basic function of technology budgeting tools (see Exhibit 4-3). Educators considering one-to-one computing now are likely to have much of the required infrastructure in place. Total cost of ownership (TCO) analyses deal with what's in place today (see Exhibit 4-4). In the future, a one-to-one program will add costs to existing line items in any education agency's budget. Value of investment tools are intended for the assessment of proposed initiatives (see Exhibit 4-5). Budget planning should account for cost savings. The move to laptops will reduce or eliminate textbook replacement or refresh costs, certain school supplies and the need to provide students with paper notices for their parents.

Perhaps the most important financial point about budgeting for one-to-one initiatives is that it entails more than capital investment (see Exhibit 4-6). Portions of the operating budget such as textbooks, professional development, curriculum development, technology funding and facility improvements may also be involved. On the one hand, this makes budgeting more complex. On the other, it offers those planning for one-to-one initiatives a good deal of flexibility in resource reallocation on the margins. Spreading the cost of implementation over many line items may protect the program's overall financial stability over time.

The continuing need for professional development was discussed earlier in this guide. It is a substantial cost over time, but the biggest "up front" investment of one-to-one initiatives is bound to be the hardware provided to students and teachers. Administrators considering one-to-one computing initiatives have four basic choices: desktops, traditional laptops, handheld devices and Tablet PCs (see Exhibits 4-7 and 4-8). Recent research has found that the Tablet PC and pen-based communication enhances student engagement, improves classroom management and teaching efficiency. A 2006 study by the Rose-Hulman Institute of Technology found that 90 percent of those surveyed felt that for effective use of a synchronous learning environment, a pen-based Tablet is important as opposed to a mouse-based laptop, for reasons that included: "faster," "more natural," and "easier to draw pictures [and annotate]." Each computing option has specific advantages and drawbacks. The selection is important because, once made, changes will impose prohibitive costs.

Sources of Funding

The long-term challenge of technology finance is beyond the scope of this handbook. Still, the price tag for the hardware, software, infrastructure, professional development and other support required for one-to-one programs to achieve their potential impact on student performance can be high. Even with stakeholder support, a new one-to-one initiative is likely to be deemed an "extra." In short, finding special funding to get one-to-one initiatives rolling is also a challenge.

Virtually every one-to-one initiative will be financed with a combination of federal, state, local funding and philanthropy (see Exhibit 4-9). The right mix will depend on the circumstances surrounding each program.

Local funding depends on a variety of tax mechanisms, but especially special levies. State funding varies widely (see Exhibit 4-10). Foundation grants are available to school districts or school sites that apply for them. Millions of dollars are provided annually — some on a one-time basis, others renewable on the basis of results. Many Web sites exist as resources, but the best approach to a comprehensive list is to search online with a phrase such as "technology grants for education."

The single most important source of federal funding is the U.S. Department of Education. Historically, Title II, Part D of the Elementary and Secondary Education Act, known as the Enhancing Education Through Technology program, has been the vehicle for financing school computing projects. However, funding levels have declined over the last several years, and the future of the Act is uncertain (see Exhibit 4-11). Those planning one-to-one initiatives will have to be creative in their approach to other Department of Education programs that are not specifically aimed at technology, but open to the use of technology to achieve program goals, and other federal agencies' education and education technology programs.

Exhibit 4-1

An Exemplary Checklist

From *Lessons Learned About Providing Laptops for All Students,* Alejandra Bonifaz and Andrew Zucker, Northeast and the Islands Regional Technology in Education Consortium, 2004

Planning

- *Align the laptop initiative with your goals*
  - *- Focus on key goals for students' learning*
  - *- Align your technology policies and supports with your goals*
- *Build a strong leadership team at all levels*
  - *- Meet on a regular basis*
- *Think about funding for the long term*
  - *- Use outside funds when possible*
- *Develop solid partnerships both inside and outside the school system*
- *Take into account stakeholders' level of interest in the one-to-one initiative and demonstrate success early*
  - *- Develop business partnerships*
  - *- Develop partnerships with evaluators*
- *Plan logistical details carefully*
  - *- Help protect the computers*
  - *- Set up filters and other control mechanisms for laptops*
  - *- Design systems for distribution and for daily management*

Training and Professional Development

- *Provide training and professional development for teachers and administrators mainly on curriculum integration, not only on technical skills*
- *Assess the technical and professional development needs of school staff*
- *Form a "Technology Leadership Team"*
- *Use a variety of training and professional development formats*
- *Partner with local universities, education organizations, and other institutions*
  - *- Provide administrator professional development*
- *Make professional development flexible*
- *Train parents on basic technical skills and inform them about the code of conduct and rules involved*
- *Establish a training requirement for parents*
- *Create parent resource centers*

Hardware and Software

- *Provide the necessary digital content and tools*
  - *- Purchase or license digital materials*
  - *- Create e-learning curriculum writing teams*
  - *- Identify software needs and restrictions*
- *Build and maintain the necessary network infrastructure*
  - *- Assess the infrastructure and wiring needs within the school*
  - *- Support and maintain networks*
  - *- Consider purchasing display devices*
- *Make technology support available on-site as well as off-site*
  - *- Have on-site technical assistance available*
  - *- Establish clear procedures to address major technical needs off-site*
  - *- Create a student-run help desk*

Managing Change

- *Allow sufficient time for change and make it gradual*
  - Allow time for teachers to become comfortable with technology before expecting them to use it for instruction
  - Provide students with keyboarding skills
  - Expect change to be gradual
- *Foster and maintain stakeholder participation and ongoing communication*
  - Use various approaches to reach out to the broad community
  - Involve students

Monitoring and Evaluation

- *Make monitoring ongoing*
- *Conduct research or evaluation studies*
- *Look for critical influences at multiple levels of the education system*
- *Figure out what you're especially trying to teach, and measure that*
- *Look for ways to evaluate the long-term costs and benefits of the technology infrastructure*
  - Let the research question drive the choice of method

Exhibit 4-2
"How to" Guides

One-to-One Laptop Initiatives: Providing Tools for 21st Century Learners, Center for Digital Education, 2004

K-12: One-to-One Computing Handbook, Center for Digital Education, http://www.centerdigitaled.com/publications.php, January 2005

One-to-One Computing: A Guidebook to Help You Make the Right Decisions, Technology & Learning, http://www.k12blueprint.com/k12/blueprint/cd/index.php, November 2005

Toward a One-to-One World: Mobile Computing is the Lifestyle of Learning, Center for Digital Education, sponsored by Intel, 2006

Starting School Laptop Programs: Lessons Learned, Andrew Zucker, One-to-One Computing Evaluation Consortium, www.genevalogic.com/blog/wp-content/uploads/2006/08/Lessons_Learned_Brief.pdf, November 2005.

Lessons Learned about Providing Laptops for All Students, Alejandra Bonifaz and Andrew Zucker, Northeast and the Islands Regional Technology in Education Consortium, www.neirtec.org/laptop/LaptopLessonsRprt.pdf, 2004

Classroom Connections Project: Initiative for One-to-One Computing in South Dakota Schools, http://www.classroomconnections.k12.sd.us/

Exhibit 4-3
Budgeting for One-to-One Initiatives

From *CoSN's Value of Investment Leadership Initiative* Web site home page, www.edtechvoi.org, 2007

Value of Investment in technology and Total Cost of Ownership for technology are related concepts and complementary, but different in focus. TCO looks at the installed (and optionally the planned) computer environment costs, while VOI looks at the anticipated costs and benefits of technology projects.

The focus of a TCO assessment is to capture and understand of all of the costs incurred for a distributed computing environment for all or a part of the school or district. A TCO assessment helps district leaders to understand all of the costs that make up the networked computer environment, including equipment and software, direct labor, and user overhead. This information can be used to plan for better efficiencies and to help determine costs for planned projects, based on historical costs. See CoSN's TCO Web site, www.classroomtco.org, for more information.

The focus of VOI is to project the costs and related benefits of specific proposed technology projects. On the cost side, while anticipated budgeted initial and ongoing costs are very important, the anticipated project TCO is critical for determining all of the anticipated project costs over the life of the project. Benefits include any dollar savings, efficiencies or additional revenue generation, but also need to take into account qualitative benefits that relate directly to school mission, goals and mandates.

Exhibit 4-4
Total Costs of Computer Ownership

From *A School Administrator's Guide to Planning for Total Cost of New Technology,* Consortium for School Networking, 2001

After a district has purchased computers and installed a networking infrastructure, here are the major expenses and technology decisions for which school administrators must be prepared...

Retrofitting: When your district is ready to build a network, has it budgeted adequately to upgrade electrical capacity, improve heating, cooling and ventilation systems, beef up security systems and remove asbestos and lead found in older buildings?...

Professional Development: If staff members are not properly trained, teachers will not understand how to integrate technology into the curriculum, support staff will not keep up to speed on hardware and software developments and the district will fail to achieve the maximum return on its technology investment.

Software: Has your district budgeted adequately for network management software, computer-based curriculum materials, applications and productivity software and the software needed to adapt technology to the special needs of users? A wide variety of software applications will give school districts greater flexibility, but will also increase the costs for support and staff development...

Support: The way in which a district deploys a network, and the variety of software and operating systems that it chooses to support, will determine the kind of support that it will need. Some new approaches have been designed to address the particular challenges that school districts can face when they try to provide their own tech support.

Replacement Costs: The life cycle of even the most advanced multimedia computer is still only about five years...

Connectivity: Lower-bandwidth connections will generally cost less but will involve a tradeoff in the complexity of the information that can be shared and the amount of time it will take to download files or access information.

Exhibit 4-5
Value of Investment in Computing Initiatives

From *CoSN's Value of Investment Leadership Initiative* Web site methodology page, www.edtechvoi.org/methodology, 2007

VOI methodology consists of six key steps:

1. Determine costs: This includes amortized initial costs (e.g., purchase of equipment, user time for development and setup), ongoing direct costs (e.g., licensing fees, ongoing professional development and support), and indirect costs (e.g., user time spent troubleshooting and dealing with system issues). Essentially, step one focuses on the TCO for the entire project.

2. Calculate any savings: In analyzing the anticipated benefits of a project, users of the VOI tools begin by looking at the potential financial savings. In broad terms, this includes determining the savings from reduced current expenditures, future cost avoidance, staff productivity gains and increased revenue.

3. Score benefits: Since many project goals and benefits go beyond financial considerations, a scoring model is used to determine benefits and their effect on district mission, goals, mandates and other requirements. So that they can be measured, these benefits are stated in numerical terms. Typically, this is the most difficult part of the process but taking the time to quantify allows the school or district to evaluate results over time.

4. Identify risk: Consensus is used to determine the probability that the project will be considered successful in terms of cost and benefits. District planners are asked to determine the probability of success and this is applied to the benefits score.

5. Compare: Projects competing for the same funding using costs and scoring model can be compared and projected costs and benefits stated concisely.

6. Measure success: With benefits and costs stated in measurable terms, one can later evaluate the results. This is not only good practice for improvement of the VOI process, but a means of providing ongoing justification for sustainability of a successful project

Exhibit 4-6
A One-to-One Computing Budget

Arizona VOI Case Study: One-to-One Student Computing, Consortium for School Networking, 2007

One-to-one Student Laptops - 900Units

Direct (budgeted) Expenses

Cost Category	Cost Factor	Initial Cost	Amortized Years (1)	Annualized (Calculated)	Annual Ongoing Cost (2)	TCO (Annualized)
Computer & Network Technology	Computer, network and software technology purchases. Note that all items included in a lease should be included as annual expenses (not initial cost).					
	Purchase/lease Client Notebook Computers	0	4	0.00	350,000.00	350,000.00
	Purchase Client Computer Software	0	7	0.00	100,000.00	100,000.00
	Purchase/lease Server(s)	0	5	0.00	9,000.00	9,000.00
	Purchase Server Software	20,000	7	2,857.14	5,000.00	7,857.14
	New Network Switches, Routers	25,000	7	3,571.43	0.00	3,571.43
	Purchase Wireless Access Points	100,000	7	14,285.71	0.00	14,285.71
	Purchase/lease Printers	20,000	7	2,857.14	0.00	2,857.14
	Interactive Whiteboards	48,000	7	6,857.14	6,857.00	13,714.14
	Other	105,000	7	15,000.00	0.00	15,000.00
	Computer & Network Technology	**318,000.00**		**45,428.56**	**470,857.00**	**516,285.56**
External IT Services	External Application Provider(s)	0	1	0.00	50,000.00	50,000.00
	External IT Services	**0**		**0**	**50,000.00**	**50,000.00**
Implementation Direct Labor	Project Planning	15,000	7	2,142.86	0.00	2,142.86
	Project Management	25,000	7	3,571.43	0.00	3,571.43
	Finance and Administration	8,000	7	1,142.86	0.00	1,142.86
	Client Computer Installation	12,500	7	1,785.71	0.00	1,785.71
	Provide User Training for this Project	3,000	7	428.57	0.00	428.57
	Curriculum Development	3,000	7	428.57	0.00	428.57
	Consultants and Contractors	30,000	7	4,285.71	0.00	4,285.71
	Travel	5,000	7	714.29	0.00	714.29
	Implementation Direct Labor	**101,500.00**		**14,500.00**	**0**	**14,500.00**
Ongoing Direct Labor	Technical Services	0	1	0.00	20000.00	20000.00
	Service Desk	0	1	0.00	15000.00	15000.00
	Curriculum Development & Support	0	1	0.00	5000.00	5000.00
	Ongoing Direct Labor	**0**		**0**	**40,000.00**	**40,000.00**
Implementation Indirect Labor	This category consists mainly of the cost of user time spent in training, such as overtime, honorarium or substitute teacher expenses.					
	Teacher/staff Training Time	10000	7	1428.57	0.00	1428.57
	Implementation Indirect Labor	**10,000.00**		**1,428.57**	**0**	**1,428.57**
Electrical & HVAC	Electrical Service Upgrades	10000	7	1428.57	0.00	1428.57
	Backup Power Supplies	30000	7	4285.71	0.00	4285.71
	Electrical & HVAC	**40,000.00**		**5,714.28**	**0**	**5,714.28**
	Direct (budgeted) Expenses Subtotal	**469,500.00**		**67,071.41**	**560,857.00**	**627,928.41**

Indirect (unbudgeted) Costs

Cost Category	Cost Factor	Initial Cost	Amortized Years (1)	Annualized (Calculated)	Annual Ongoing Cost (2)	TCO (Annualized)
Ongoing Indirect Labor	Ongoing Indirect Labor is user time spent dealing with system problems, down-time and time in training. This time is not part of school budgets and does not show up as part of total ongoing cost; however it is an important part of TCO.					
	Assisting Others	0	1	0.00	20500.00	20500.00
	Ongoing Indirect Labor	**0**		**0**	**20,500.00**	**20,500.00**
	Indirect (unbudgeted) Costs Subtotal	**0**		**0**	**20,500.00**	**20,500.00**
	TOTAL PROJECTED COST OF OWNERSHIP:	**469,500.00**		**67,071.41**	**581,357.00**	**648,428.41**

(1) Major one-time purchases should be amortized over the expected life of the project, up to 5 years (longer for building refurb)
(2) Ongoing costs include ongoing support and equipment leasing

Exhibit 4-7
Hardware Options

Based on a framework suggested by Lorrie Jackson in "The 411 on One-to-One Computing," *Education World,* http://www.education-world.com/a_tech/tech/tech194.shtml.

Desktops often constitute most of any school's or district's installed computer base. They offer the highest level of functionality; students and teachers know how to use them; technology support ad educational materials are readily available, and they are relatively low-cost. However, they are not mobile and constitute physical barrier to interaction between students and between the teacher and the class. They have been considered as an option, but unless students have independent access to the Internet they undermine the idea of anytime, anywhere computing.

Handheld devices are the least expensive and most portable option. They are more flexible than the typical desk or laptop because, input can be accomplished by touching the screen or keyboard. But their functionality is limited to specific programs designed for handheld operating systems and they require specific training and technical support. And while they do not block student's views of each other or the teacher in class, their small screen size makes it more difficult for teachers to observe student work directly and harder for students to integrate their work on computer with their interaction in class.

Laptops are the most popular one-to-one option. They merge many of the desktop's and handheld's positive attributes. But they are more expensive than either, and because inputs can only be made via the keyboard, they lose one very useful feature. Moreover, the screen does serve as a barrier between the teacher and student, making it more difficult for the teacher to directly observe student's computer use and possibly more difficult to manage the class.

Tablet PCs are marginally more expensive than laptops, but they offer two important additional features. First, by allowing the student to input by touching the screen or using a stylus, Tablet PCs permit students to focus on the content of learning rather than the process by which they enter data. Second, the tablet screen can be placed flat on the desk, offering teachers and students views of each other more conducive to group exchange.

Exhibit 4-8
Introducing the Tablet PC

From "What is a Tablet PC?" Microsoft, http://www.microsoft.com/windowsxp/tabletpc/evaluation/about.mspx, 2005

Computers... equipped with a sensitive screen designed to interact with a complementary pen, are called Tablet PCs. Tablet PCs are fully-functional laptop PCs and more. You can use the pen directly on the screen just as you would a mouse to do things like select, drag, and open files; or in place of a keyboard to handwrite notes and communication. Unlike a touch screen, the Tablet PC screen only receives information from a special pen. It will not take information from your finger or your shirt sleeve — so you can rest your wrist on the screen and write naturally.

By interacting directly with the screen, rather than with a mouse and keyboard, the PC becomes more comfortable and easy to use. There is no need to find a flat space on which to use your PC, nor does a vertical screen become a dividing wall between you and the person with you whom you are meeting. What's more, a Tablet PC can even be used while standing up...

Three different styles of Tablet PCs are available...

The convertible model Tablet PC has an attached keyboard and looks much like a conventional laptop PC. But you can also rotate the screen 180 degrees and lay it flat over the keyboard for a more comfortable reading and writing experience.

The slate model Tablet PC is designed to be slim and ultra-light without the weight and size of a permanent keyboard. Some models come with a detachable keyboard, and all include innovative docking solutions that offer access to a full-size monitor, keyboard, and mouse.

The rugged model Tablet PC is a tough mobile computer with an industrial-strength shell and shock-mounted hard drive. Rugged models are ideal for people who use their PC in a construction zone, while on patrol, in military situations, or simply for those who need something ultra durable.

Along with the options typically provided by a conventional laptop, Tablet PCs are certain to include:
- *Mid- to high-end processors optimized for mobile computing*
- *High memory capacity for most computing needs*
- *High capacity hard drive storage space*
- *Built-in modem for wireless and networking connectivity*
- *Tablet PC-compatible electronic pen*
- *Tablet PC-compatible digitizer screen*

Exhibit 4-9
Potential Sources of Funding

U.S. Department of Education:
http://www.ed.gov/programs/gtep/index.html?src=fp

• **Enhancing Education Through Technology (Title II, Part D):** improve student achievement through the use of technology in elementary and secondary schools, helping all students become technologically literate by the end of the eighth grade and, through the integration of technology with both teacher training and curriculum development, establishing research based instructional methods that can be widely implemented States award subgrants: half by formula to eligible local education agencies (LEAs); half by competition to eligible "local entities," which must include a "high need local education agency."

• **Star Schools:** support distance education projects that encourage improved instruction in mathematics, science, foreign languages, and serve underserved populations. Enable partnerships to operate telecommunications facilities, acquire educational and instructional programming; and obtain technical assistance for the use of such facilities and programming.

• **Tech Prep Education:** grants to consortia of LEAs and postsecondary education institutions for the development and operation of programs consisting of the last two years of secondary education and at least two years of postsecondary education, designed to provide Tech Prep education to the student leading to an associate degree or a two-year certificate.

• **21st-Century Community Learning Centers:** academic enrichment opportunities for children, especially in high-poverty and low-performing schools.

• **Improving Literacy Through School Libraries:** provides students access to technologically advanced school library media centers.

• **Smaller Learning Communities:** development of small, safe, and successful learning environments in large high schools as apart of comprehensive improvement plans to create a more personal experience for students.

• **Education for Homeless Children and Youths — Grants for State and Local Activities:** competitive subgrants to LEAs to facilitate the enrollment, attendance, and success in school of homeless children and youths. This includes addressing problems due to transportation needs, etc.

• **Improving Basic Programs Operated by Local Education Agencies (Title I, Part A):** financial assistance to LEAs and schools with high numbers or high percentages of poor children to help ensure that all children meet challenging state academic standards. Provide additional academic support and learning opportunities to help low-achieving children master challenging curricula and meet state standards in core academic subjects. Schools in which poor children make up at least 40 percent of enrollment are eligible to use Title I funds for school-wide programs that serve all children in the school.

• **Reading First:** subgrants to eligible LEAs on a competitive basis. SEAs fund those proposals that show the most promise for raising student achievement and for successful implementation of reading instruction, particularly at the classroom level. Only programs that are founded on scientifically based reading research are eligible for funding.

• **Striving Readers:** support the implementation and evaluation of research-based reading interventions for struggling middle and high school readers in Title I eligible schools that are at risk of not meeting or are not meeting adequate yearly progress (AYP) requirements under the No Child Left Behind Act, or that have significant percentages or number of students reading below grade level, or both.

• **Education Research:** research to improve education at all levels. See individual program announcements.

• **Small Business Innovation Research (SBIR) Program:** stimulate technological innovation and increase small business participation in federal research and development and increase private sector commercialization of technology derived from federal research and development. Research and development projects that propose a sound approach to the investigation of an important education or assistive technology, science, or engineering question under topics identified each year in the solicitation.

• **Fund for the Improvement of Education — Programs of National Significance:** programs at the state and local levels designed so that their effectiveness is readily ascertainable and is assessed using rigorous, scientifically based research and evaluations.

• **Innovative Programs:** state-administered formula grant program designed to improve student academic achievement and the quality of education for all students. Funding may be used for 27 allowable program areas, including instructional and educational materials, technology, school improvement, school and education reform, and meeting the education needs of at-risk students.

• **Magnet Schools Assistance:** applies only to LEAs or consortia of LEAs that are implementing court-ordered or federally approved voluntary desegregation plans that include magnet schools offering a wide range of distinctive education programs.

• **Mathematics and Science Partnerships:** partnerships of local education agencies and institutions of higher education (IHEs) apply to states for subgrants. Projects to improve math and science education.

• **School Leadership Program:** grants to support the development, enhancement, or expansion of innovative programs to recruit, train, and mentor principals (including assistant principals) for high-need schools.

• **Teacher Quality Enhancement Grants:** partnerships of an IHE with a high-performing teacher preparation institution, a college of arts and sciences, and a high need LEA for projects to make lasting changes in the ways teachers are supported.

• **Ready-to-Teach Grant Program:** projects that promote online professional development for teachers in core curricular areas and projects that develop, distribute, and produce educational video programming.

National Science Foundation:
http://nsf.gov/funding/pgm_list.jsp?org=EHR

U.S. Department of Energy:
http://www.sc.doe.gov/grants/grants.html#Grant Solicitation Notices

National Aeronautics and Space Administration:
http://education.nasa.gov/divisions/eleandsec/grants/index.html

U.S. Department of Agriculture:
http://www.usda.gov/rus/telecom/dlt/dlt.htm

State Educational Technology Directors Association Funding Opportunity Library:
http://www.setda.org/web/guest/compgrants-fundingop

State Reports:
http://states2.metiri.com/

Exhibit 4-10

State Government Technology Spending FY 2007

SETDA State Educational Technology Funding Report: State of the States 2007, State Educational Technology Directors Association, http://www.setda.org/web/guest/nationaltrendsreport, 2007

Direct State Funding by General Category

*This appendix attempts to identify general categories; however, there may be overlap within categories and states may use variations in category definitions.

	Ed Tech	End-user		Professional	Data
State	Infrastructure	Technology	Development	Warehousing	Total
Alabama	$4,000,000	$18,320,359	$1,352,399	$0	$23,672,758
Alaska	$0	$0	$0	$0	$0
Arizona	$0	$0	$0	$0	$0
Arkansas	$16,500,000	$2,100,000	$0	$2,000,000	$20,600,000
California	$15,600,000	$0	$0	$0	$15,600,000
Colorado	$0	$0	$0	$0	$0
Connecticut	$5,000,000	$0	$0	$0	$5,000,000
Delaware	$0	$0	$0	$0	$0
District of Columbia	$0	$0	$0	$0	$0
Florida	$8,840,349	$0	$0	$1,000,000	$9,840,349
Georgia	$0	$0	$0	$0	$0
Hawaii	$2,375,558	$1,428,858	$115,237	$204,748	$4,124,401
Idaho	$0	$8,990,000	$0	$0	$8,990,000
Illinois	$0	$0	$0	$0	$0
Indiana	$3,500,000	$2,500,000	$14,000,000	$0	$20,000,000
Iowa	$0	$500,000	$0	$2,000,000	$2,500,000
Kansas	$0	$0	$0	$0	$0
Kentucky	$6,277,876	$2,379,342	$212,452	$1,285,592	$10,155,262
Louisiana	$0	$20,000,000	$1,000,000	$0	$21,000,000
Maine	$3,472,335	$5,208,503	$1,736,168	$500,000	$10,917,006
Maryland	$0	$0	$0	$0	$0
Massachusetts	$0	$0	$0	$5,200,000	$5,200,000
Michigan	$0	$0	$0	$0	$0
Minnesota	$3,750,000	$0	$0	$0	$3,750,000
Mississippi	$0	$0	$0	$0	$0
Missouri	$3,655,000	$0	$24,643,948	$0	$28,298,948
Montana	$0	$0	$0	$0	$0
Nebraska	$0	$0	$0	$0	$0
Nevada	$482,500	$2,582,500	$1,492,500	$600,000	$5,157,500
New Hampshire	$0	$0	$0	$0	$0
New Jersey	$0	$0	$0	$0	$0
New Mexico	$1,500,000	$5,000,000	$2,400,000	$2,000,000	$10,900,000
New York	$0	$0	$0	$0	$0
North Carolina	$6,000,000	$18,000,000	$0	$13,000,000	$37,000,000
North Dakota	$1,700,000	$1,825,000	$55,000	$0	$3,580,000
Ohio	$454,998	$6,071,296	$3,004,673	$0	$9,530,967
Oklahoma	$0	$0	$0	$0	$0
Oregon	$0	$0	$0	$1,800,000	$1,800,000
Pennsylvania	$10,000,000	$29,000,000	$4,000,000	$2,000,000	$45,000,000
Rhode Island	$1,600,000	$2,500,000	$500,000	$500,000	$5,100,000
South Carolina	$0	$0	$0	$0	$0
South Dakota	$7,704,832	$2,256,450	$200,226	$759,481	$10,920,989
Tennessee	$0	$0	$0	$0	$0
Texas	$55,200,000	$20,700,000	$39,100,000	$0	$115,000,000
Utah	$20,000,000	$0	$0	$0	$20,000,000
Vermont	$0	$0	$0	$500,000	$500,000
Virginia	$14,582,500	$45,683,672	$0	$7,593,796	$67,859,968
Washington	$1,939,000	$0	$1,959,000	$126,000	$4,024,000
West Virginia	$1,340,000	$9,336,000	$2,670,000	$0	$13,346,000
Wisconsin	$17,000,000	$0	$40,000	$0	$17,040,000
Wyoming	$4,800,000	$0	$0	$0	$4,800,000
Subtotals	$217,274,948	$204,381,980	$98,481,603	$41,069,617	$561,208,148

Exhibit 4-11

Federal Enhancing Education Through Technology (Title II, Part D) Funding by State

National Trends Report 2007, State Educational Technology Directors Association, http://www.setda.org/web/guest/nationaltrendsreport, 2007

States:	Round 1: FY 2002 Final State Allocations	Round 2: FY 2003 Final State Allocations	Round 3: FY 2004 Final State Allocations	Round 4: FY 2005 Final State Allocations
Alabama	$8,794,248	$9,690,136	$9,868,971	$7,242,783
Alaska	$3,075,155	$3,214,970	$3,304,308	$2,400,020
Arizona	$10,114,346	$9,655,054	$12,202,519	$9,256,875
Arkansas	$5,518,844	$5,465,161	$6,146,287	$4,580,515
California	$85,123,372	$89,959,919	$93,318,376	$65,574,712
Colorado	$5,569,804	$5,489,698	$5,942,011	$4,519,529
Connecticut	$6,158,638	$5,209,647	$5,452,429	$3,820,259
Delaware	$3,075,155	$3,214,970	$3,304,308	$2,400,020
District Of Columbia	$3,075,155	$3,214,970	$3,304,308	$2,400,020
Florida	$28,312,771	$29,241,808	$30,855,668	$22,812,919
Georgia	$18,588,457	$18,645,145	$20,179,473	$15,158,492
Hawaii	$3,075,155	$3,214,970	$3,304,308	$2,400,020
Idaho	$3,075,155	$3,214,970	$3,304,308	$2,400,020
Illinois	$25,456,201	$25,908,318	$27,637,866	$19,883,862
Indiana	$8,959,597	$7,836,888	$8,567,373	$6,381,529
Iowa	$3,535,415	$3,214,988	$3,304,308	$2,400,020
Kansas	$4,295,513	$4,739,996	$4,165,751	$2,890,894
Kentucky	$8,799,115	$8,608,243	$8,907,782	$6,997,426
Louisiana	$11,460,981	$14,168,071	$14,283,472	$10,412,348
Maine	$3,075,155	$3,214,970	$3,304,308	$2,400,020
Maryland	$9,146,822	$8,092,948	$8,771,084	$6,410,750
Massachusetts	$12,793,954	$14,154,554	$11,141,968	$8,277,125
Michigan	$24,296,861	$20,457,029	$20,978,706	$15,902,017
Minnesota	$6,594,336	$6,055,412	$5,017,495	$3,901,408
Mississippi	$6,105,610	$8,315,118	$8,294,144	$6,120,421
Missouri	$9,312,229	$9,557,431	$8,064,903	$7,105,178
Montana	$3,075,155	$3,214,970	$3,304,308	$2,400,020
Nebraska	$3,075,155	$3,214,970	$3,304,308	$2,400,020
Nevada	$3,075,155	$3,214,970	$3,462,269	$2,611,088
New Hampshire	$3,075,155	$3,214,970	$3,304,308	$2,400,020
New Jersey	$14,970,765	$13,972,432	$13,525,534	$9,794,681
New Mexico	$4,856,313	$5,774,873	$6,189,971	$4,029,912
New York	$60,907,113	$64,948,122	$65,722,083	$45,146,951
North Carolina	$12,685,051	$14,721,370	$14,392,700	$10,778,695
North Dakota	$3,075,155	$3,214,970	$3,304,308	$2,400,020
Ohio	$19,229,051	$21,866,049	$21,037,126	$14,159,498
Oklahoma	$7,091,048	$6,646,069	$7,363,973	$5,105,476
Oregon	$5,495,169	$6,253,983	$7,002,352	$4,544,889
Pennsylvania	$22,784,432	$23,425,221	$22,235,814	$17,707,678
Rhode Island	$3,075,155	$3,214,970	$3,304,308	$2,400,020
South Carolina	$8,393,257	$8,651,744	$8,784,800	$6,641,082
South Dakota	$3,075,155	$3,214,970	$3,304,308	$2,400,020
Tennessee	$8,285,988	$10,282,694	$10,665,088	$7,591,908
Texas	$50,721,663	$55,794,699	$59,385,629	$44,009,272
Utah	$3,075,155	$3,214,970	$3,304,308	$2,400,020
Vermont	$3,075,155	$3,214,970	$3,304,308	$2,400,020
Virginia	$10,364,389	$9,917,162	$10,334,465	$8,099,082
Washington	$8,266,254	$8,312,350	$8,951,900	$6,543,660
West Virginia	$4,506,136	$5,106,182	$4,954,589	$3,853,731
Wisconsin	$8,498,770	$7,546,299	$8,353,969	$5,934,266
Wyoming	$3,075,155	$3,214,970	$3,304,308	$2,400,020
Total	**$595,194,993***	**$619,124,333***	**$635,027,468***	**$462,201,231***

*Totals do not include allocations to U.S. Territories.
Source: Allocations from http://www.ed.gov, accessed 11/15/06, updated by state survey reports.

Resources for **Investment Planning**

"What is a Tablet PC?," Microsoft, http://www.microsoft.com/windowsxp/tabletpc/evaluation/about.mspx, 2005

"The 411 on One-to-One Computing", Lorrie Jackson, *Education World,* http://www.education-world.com/a_tech/tech/tech194.shtml.

Arizona VOI Case Study, One-to-one Student Computing, Consortium for School Networking, July 2007

SETDA State Educational Technology Funding Report: State of the States 2007, State Educational Technology Directors Association, http://www.setda.org/web/guest/nationaltrendsreport, 2007

National Trends Report 2007, State Educational Technology Directors Association, http://www.setda.org/web/guest/nationaltrendsreport, 2007

Guide to U.S. Department of Education Programs: 2007, Office of Communications and Outreach, U.S. Department of Education, http://www.ed.gov/programs/gtep/gtep.pdf, August 2007

A Report and Estimating Tool for K-12 School Districts: Why Total Cost of Ownership (TCO) Matters, Gartner, April 2003

A School Administrator's Guide to Planning for the Total Cost of New Technology, Consortium for School Networking, July 2001

Section **Five**

Blue Ribbon One-to-One Deployments

South Dakota Classroom Connections

The South Dakota Classroom Connections one-to-one program is part of Gov. Mike Rounds' 2010 Education Initiative. The 2010 Education Initiative stresses the importance of increasing 21st century skills through the use of advanced technology to enhance learning, and includes the implementation of a one-to-one laptop initiative for high school students.

The goal of the Classroom Connections laptop initiative is to provide incentive money for school districts to initiate one-to-one laptop programs for high school students.

The state chose Gateway as its laptop and Tablet PC provider for the initiative.

In May 2006, 20 school districts were chosen as pilot schools for the project. In March 2007, 21 new school districts were selected to participate in the program, bringing the total number of high school students with laptops to 9,600 in 41 districts across the state.

"Twenty-first century skills are an absolute must in today's world. Workers need to be able to problem solve, write and speak effectively, and be technology literate," said Gov. Mike Rounds. "Use of the laptop technology is expected to enhance many of these skills."

Auburn City Schools' 21st Century Learning Initiative

Auburn City Schools in Alabama initiated a program to provide a Wi-Fi -enabled Tablet PC to every ninth-grader at Auburn Junior High School. Beginning in the 2006-07 school year, all ninth-graders received Tablet PCs to keep through their senior year at Auburn High School. A wireless network was deployed in the district schools to provide ubiquitous connectivity for the Tablet-equipped students.

The Tablets enhance students' learning abilities by enabling them to use computer applications such as spreadsheets and word processing programs, access online resources and use the Internet for researching projects and assignments.

The Tablet PCs are just one aspect of the district's technology plan and goals for 21st century learning. All teachers have a desktop or a laptop computer with Internet access. Computers are available in each classroom for student use. Each school has at least one computer lab and 95 percent of K-12 classrooms have LCD projectors. In addition, all K-9 classrooms are equipped with interactive whiteboards for instruction.

This technology infusion is having a positive impact on classroom instruction. The 21st Century Learning Initiative drastically changed my teaching [during the] 2006-07 school year," according to teacher Kelly Durkin. She adds that students actually learned more than in years past. "Each student has pride in his or her laptop," she says. "For the most part, they treat them with respect and are proud to have such a unique learning tool. That is how I view the laptops — as a learning tool. They are an extension of my other teaching methods — discussion, lecture, cooperative learning, et cetera. I am excited about the future with the laptops. The laptops are an asset to Auburn City Schools. They allow teachers to be better educators and students to be better students."

Sergeant Bluff-Luton School District

The Sergeant Bluff-Luton School District in Iowa purchased Gateway Tablet PCs for all K-12 teachers in the summer of 2007. Teachers were trained on the use and care of the machines over a two-day period prior to the start of the 2007-08 school year. The district purchased wireless projectors, which were mounted in almost all of the third- through 12th grade classrooms. The district also provided projectors on a mobile cart for each K-2 teacher.

"We are very pleased with this purchase," says Curriculum Director Brad McCauley. "It has had a positive impact on the morale of the staff and the engagement of the students." McCauley adds that he surveyed the staff after two months of tablet and projector use in the classroom and asked if students were engaged more, less, or about the same. "Eighty-six percent of respondents said that students were more engaged in their classroom," he says. "None of the respondents reported less engagement."

In addition to the hardware, the district is also providing professional development to its staff in the use of Microsoft Office 2007 — including Word, Excel and PowerPoint. Each training session lasts one day, and also focuses on how to infuse these programs into instruction. To accomplish this, the district utilizes a "train the trainer model," in which four teachers and their principals attend a training session approximately one month before they would then train their school. The initial instruction is provided by Knowledge Network System (KNS), which was recommended by Gateway as a provider of staff development.

"Our ultimate goal is to provide one-to-one computing for our students in grades six through 12," says McCauley. "We felt it was necessary to equip teachers and classrooms to insure long-term success of the infusion of technology."

The John Carroll School

All full-time faculty members at the John Carroll School in Bel Air, Md., received Tablet PCs in May 2005, and the school is implementing a one-to-one computing program beginning with the Class of 2010. The school's Tablet PC Laptop Computer Program aims to prepare students for college and the professional world where computer use is the standard. School leaders believe a one-to-one computer-to-student ratio is the optimal way for students to use technology to search the Internet, compose documents, construct spreadsheets, send e-mail, create graphics, organize presentations and build databases. Each classroom will provide students with swift, convenient, wireless access to the resources of the Internet. The Tablet PCs and the school's wireless network provide anywhere and anytime access and are not dependent on students being in a particular location, such as a computer lab. Student work can be saved and stored, making it available on and off campus. Routine tasks such as note-taking are made easier.

How has the school prepared?
- Security
- Firewalls and other security applications are in place.
- Proper storage when the Tablet PC is not in use.
- Support staff
- Dedicated information technology specialists.
- Staff mentors for technology integration assistance.
- Student training assistants for guidance and support.
- Ongoing intense faculty and staff development
- Currently active faculty training program supported by the Archdiocese of Baltimore and the Maryland State Department of Education.
- Coordination with national training standards.
- Quality student training
- Online assessment tool to diagnose student skills before freshman year begins.
- Student assistance program to allow peer mentoring and problem solving.
- Training programs for initial and ongoing use of the Tablet PC.
- Specialized software training.

John Carroll takes a unique approach; the school will own the computers. Families will essentially lease the computers, spreading the cost over a four-year period of time. The school will have warranty coverage of the computers. Families will be required to insure the computers against theft.

Chicago Public Schools' Technology Immersion Pilot Project
Chicago Public Schools is the third-largest school district in the nation, and is home to more than 400,000 students. In order to ensure that no Illinois child is left on the wrong side of the digital divide, Illinois Lt. Gov. Pat Quinn and the Illinois State Board of Education created the Technology Immersion Pilot Project.

This initiative will provide one-to-one computing environments in public schools across the state. The General Assembly appropriated $5 million to launch the Technology Immersion Pilot Project in seven school districts in the 2006-07 school year.

Participating schools receive:
- Laptop computers for all participating students and classroom teachers
- Professional development opportunities for teachers
- Technical assistance for school based networks

Due to the program's success in 2007, funding was extended into phase two for the 2008 school year. "No Illinois child should be left on the wrong side of the digital divide," Quinn said. "Laptops are the textbooks of tomorrow, and I salute these schools for participating in an innovative program that helps their students learn any time and anywhere."

TIPP Fast Facts:
- 9 Chicago schools participating
- 7 PC schools, 2 Mac schools
- 1,526 laptops gifted in first 2 phases
- 1,242 Gateway Tablets, 284 Mac iBooks
- $10 million invested state-wide in two years

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