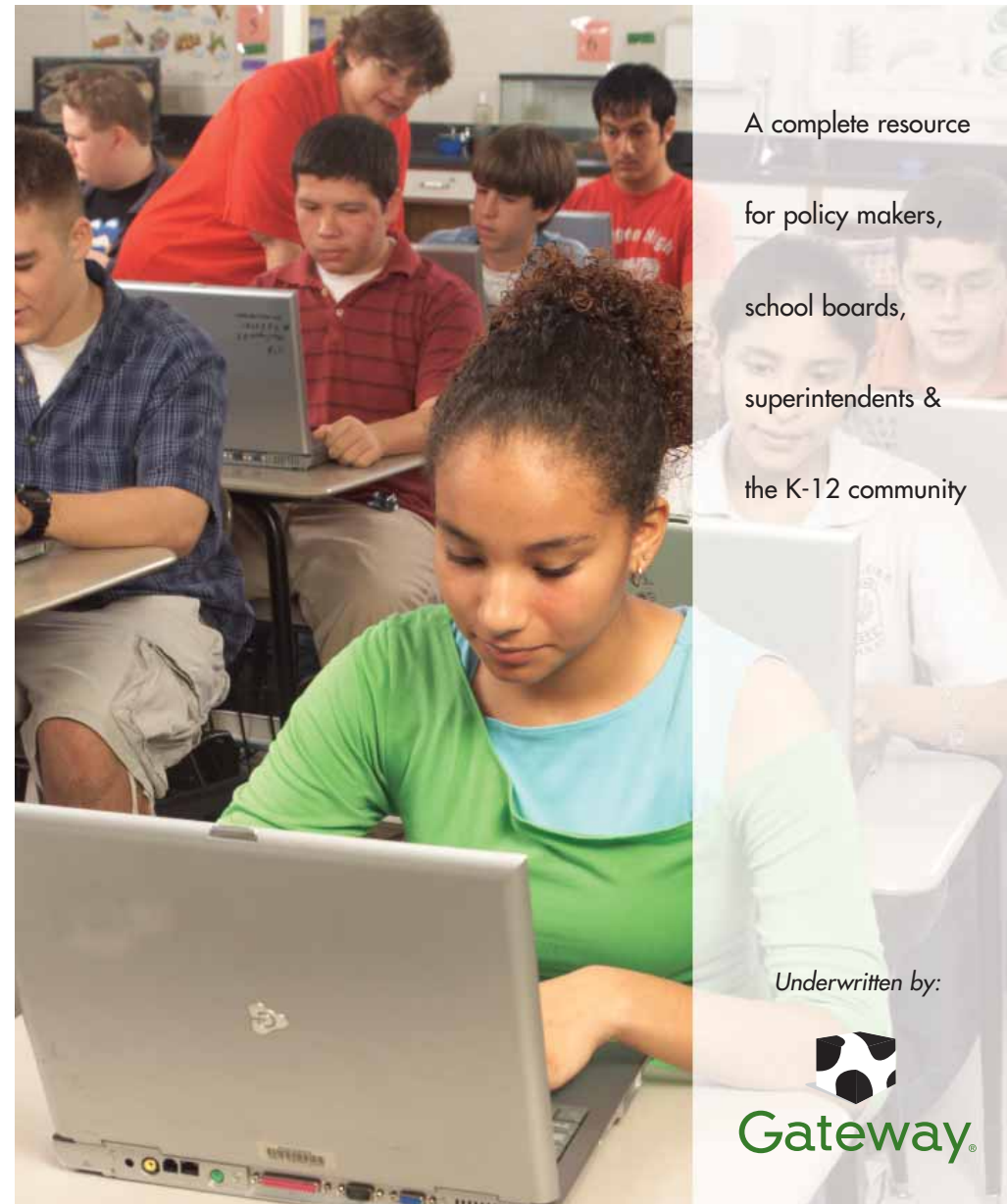


# K-12

## One-to-One Computing Handbook



A complete resource  
for policy makers,  
school boards,  
superintendents &  
the K-12 community

Underwritten by:



### About Center for Digital Education

The Center for Digital Education, a division of e.Republic, Inc., is a leading resource on information technology policy, trends and opportunities in K-12 and higher education. The Center offers a series of unique programs covering the critical policies, executive leadership and applications surrounding education technology.  
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A COMPLETE STRATEGY GUIDE ON STUDENT COMPUTING

Cover photo: A one-to-one computing classroom in Harlingen Consolidated School District.

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# K-12 | One-to-One Computing Handbook

A complete resource for policy makers, school boards,  
superintendents & the K-12 community

# Advice from K-12 administrators about one-to-one programs.

“Do it, jump in and do not worry about it. It is very important to get the necessary support staff and realize that you will never get “buy-in” from everyone, but it is critical to have the majority.”

“Ask for help early and often from a school that has gone through a successful Student Laptop Initiative. Find vendors you can trust and build relationship with them. You must create “believers” out of your divisional principals. Also, it is important to have a one-year, a five-year, and a ten-year plan.”

“It is not the laptop or the technology that determines the success of the project; it is what you do with the equipment. If you are going to embark on this type of project, do it because it enhances learning, not because it is fashionable. Develop a program that will engage teachers and students in the learning process.”

“Project based learning is a proven, effective method.”

— various responses from Center for Digital Education research

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“After the rollout,  
attendance is up ...  
Many schools  
reported 100  
percent attendance  
two weeks after  
the rollout.”

– Anita Givens,  
Sr. Director of Instructional  
Materials and Education  
Technology,  
Texas Education Agency

# About This Guide

This handbook is for superintendents, administrators, educators, parents and others interested in understanding the strategy for making one-to-one computing available in K-12 education. One-to-one computing – a model in which every student uses a laptop, notebook or Tablet PC – is changing classroom learning as we’ve known it and creating new possibilities for teaching.

This strategic conversation serves as a foundation to prepare decision-makers for planning, funding and implementing one-to-one computing programs.

The guide is organized as follows:

- Section 1, *Learning in the 21st Century*, introduces the changing landscape in education and current challenges for learning.
- Section 2, *Understanding One-to-One Computing*, defines one-to-one and provides guidelines for successful initiatives. This section also includes examples of K-12 one-to-one computing installations across the country and provides key findings based on research and interviews.
- Section 3, *Leadership and Readiness*, provides guidelines to prepare for one-to-one computing including a strategic planning checklist, ways to develop administrative leadership and support, and preparing the communications components such as communicating the vision and plan to parents, students and the community.
- Section 4, *Requirements for Successful Initiatives*, identifies possible computing tools and software, network connectivity and infrastructure, and information on curriculum integration and professional development.
- Section 5, *Financing a One-to-One Initiative*, provides information on funding considerations and strategies, and federal, state and local funding options.
- Section 6, *Additional Resources* offers a list of additional organizations, centers and publications for reference purposes.

For further information, references to pertinent Web sites are included throughout the text.

# Section 1. Learning in the 21st Century

## Entering a New Golden Age

Dramatic change is taking place in the educational landscape – a transformation unimagined even five years ago and unparalleled in our nation’s history. We are faced with a new excitement in the vast possibilities of the digital age, for changing how we teach, how various segments of our educational system fit together, and especially how students learn.<sup>1</sup>

The new digital marketplace, the rapid development of “virtual” schools, and the enthusiasm of an amazing generation of students weaned on the marvels of technology are literally forcing our schools to adapt and change in ways never before imagined. As one high school student put it, “We have technology in our blood.”<sup>2</sup>

Yet we also face an unparalleled challenge. Twenty-two years ago, the U.S. Department of Education’s National Commission on Excellence in Education published the landmark report, *A Nation at Risk*. It warned, “The educational foundations of our society are being eroded by a rising tide of mediocrity that threatens our very future as a nation and a people.”<sup>3</sup> The report made the case that students are not being challenged with high quality mathematics and science curricula and many are not learning basic skills. And still today, a majority of our secondary school students are not grade-level proficient in reading, mathematics or science – the very skills necessary in this time of rapidly increasing global competition.

Fortunately, for learners, this is a nation on the move and the pace is accelerating. Without overlooking the very real challenges that remain, evidence suggests strongly that we may be entering a new golden age in American education.<sup>4</sup>

The National Education Technology Plan (January 2005) is available at: [http://www.nationaledtechplan.org/docs\\_and\\_pdf/National\\_Education\\_Technology\\_Plan\\_2004.pdf](http://www.nationaledtechplan.org/docs_and_pdf/National_Education_Technology_Plan_2004.pdf).

## Realizing Dramatic Improvements

Today’s students, of almost any age, prefer to access subject information on the Internet, where it is more abundant, more accessible and more up-to-date.<sup>5</sup>

*Without question, this generation truly is the media generation, devoting more than a quarter of each day to media. As media devices become increasingly portable, and as they spread even further through young people’s environments*

As one high school student put it, “We have technology in our blood.”

— from their schools to their cars — media messages will become an even more ubiquitous presence. Anything that takes up this much space in young people's lives deserves our attention. The sheer amount of time young people spend using media — an average of nearly 6 1/2 hours a day — makes it plain that the potential of media to impact virtually every aspect of young people's lives cannot be ignored.

Source: The Kaiser Family Foundation study, *Generation M: Media in the Lives of 8-18 Year-olds*, examined media use among a nationally representative sample of more than 2,000 third-through 12th-graders. Read an executive summary at: <http://www.kff.org/entmedia/loader.cfm?url=/commonspot/security/getfile.cfm&PageID=51805>

## Goals of NCLB

- Every child can read by the third grade.
- Students are technology literate by the eighth grade.
- A highly qualified teacher in every public school classroom by 2005.
- Data used to drive decisions, target resources and support instruction.

Progressive teachers, principals and superintendents understand that technical innovations such as the Internet, digital cameras and e-mail are tools for improving learning. They have successfully adapted the endless opportunities presented by computer technology and married them in creative and challenging ways to the high-level technical capabilities and motivation of their students. The National Education Technology Plan predicts students and teachers will become partners in the exploration of this new universe. Ten years from now we could be looking at the greatest leap forward in achievement in the history of education. By any measure, the improvements will be dramatic.<sup>6</sup>

### A Comparison of Traditional and New Learning Environments

<i>Traditional Learning Environments</i>	<i>New Learning Environments</i>
Teacher-centered instruction	Student-centered learning
Single-sense stimulation	Multi-sensory stimulation
Single-path progression	Multi-path progression
Single media	Multimedia
Isolated work	Collaborative work
Information delivery	Information exchange
Passive learning	Active/exploratory/inquiry-based learning
Factual, knowledge-based	Critical thinking and informed decision-making
Reactive response	Proactive/planned action
Isolated, artificial context	Authentic, real world context

Source: International Society for Technology in Education (ISTE) NETS Project, *National Educational Technology Standards for Students*, June 1998, pg. 2.

## Achieving Accountability

Today, *No Child Left Behind* creates new standards of accountability. Students have to demonstrate improvement over time and be proficient in reading and mathematics. Achievement gaps between different socio-economic backgrounds must be identified — and closed — so that all children regardless of race and income level can read and do mathematics at grade levels by 2014.<sup>7</sup>

The U.S. Department of Education says of NCLB, “America’s students need the knowledge and competence to compete in an increasingly technology-driven world economy. This need demands new models of education facilitated by educational technology. Industry is far ahead of education. Tech-savvy high school students often are far ahead of their teachers. Some of the most promising new educational approaches are being developed outside the traditional educational system, through e-learning and virtual schools. This is an exciting, creative and transforming era for students, teachers, administrators, policymakers and parents.”

The key principles of “No Child Left Behind” are summarized in “Raising Achievement: A New Path,” the 2005 policy statement of the U.S. Department of Education.

- **Ensure students are learning:** Raising overall achievement and closing the achievement gap.
- **Make the school system accountable:** Including all students in all schools and districts in the state; ensuring all students are part of a state’s accountability system and are tested in reading and math in grades three through eight and once in high school by the 2005-2006 school year; providing data on student achievement by subgroup.
- **Ensure information is accessible and parents have options:** Informing parents in a timely manner about the quality of their child’s school and their school choice options, identifying schools and districts that need to improve, developing a dynamic list of after-school tutors, encouraging public school choice and the creation of charter schools and creating easily accessible and understandable school and district report cards.
- **Improve teacher quality:** Providing parents and the public with accurate information on the quality of their local teaching force, implementing a rigorous system for ensuring teachers are highly qualified and making aggressive efforts to ensure all children are taught by highly qualified teachers.

## Listening to Our Students

According to preliminary results from the National Governors Association’s (NGA) “Rate Your Future” high school survey, most high school students say they are adequately prepared in basic reading, math and science skills; however, more than a third of students do not feel their schools are adequately preparing them to think critically, analyze problems and communicate effectively, and 43 percent do not believe they are gaining practical and essential life skills to handle the demands of college and work.<sup>8</sup>

The National Governors Association surveyed thousands of high school students on their expectations and frustrations about America’s high schools and how the work they do affects their futures. The NGA survey is available at: <http://www.rateyourfuture.org/>.

The results suggest that secondary students must begin to understand the importance of mastering an academically rigorous high school curriculum that will help them excel in college, help them graduate from college in four

“American students are a determined generation for whom the Internet appears to have stimulated interest in learning in general and, in particular, a revival of interest in researching and innovating using technology.”

— U.S. Department of Education.

years or less, and make them a more marketable candidate in today's increasingly competitive job market.

The National Education Technology Plan urges Americans to listen to students, as they are our "ultimate constituents." ". . . They have demonstrated that they have a better understanding of the intricacies and opportunities presented by the technological revolution than many of their elders, notably including a generation of teachers and administrators who did not have the advantage of growing up with the Internet."<sup>9</sup>

The results of the Tablet PC pilot program at Houston County High School showed that students had far superior computer skills, improved ability to do online research, and produced better quality work than those students who did not have access to a Tablet PC.

## Preparing for the 21st Century Workplace

According to the U.S. Bureau of Statistics, over the next decade, the U.S. economy as a whole is expected to provide approximately 15 percent more jobs, with employment opportunities for science and engineering jobs expected to increase by 2.2 million jobs, or about 47 percent.

Interestingly, the federal Bureau of Labor Statistics predicts that approximately 86 percent of the projected increase in jobs will be in computer-related occupations including:

- Computer software engineers – increase from 697,000 to 1.4 million jobs
- Computer systems analysts – increase from 431,000 to 689,000 jobs
- Computer hardware engineering – above-average employment gains, growing by 25 percent
- Medical science occupations – addition of 10,000 new jobs, or an increase of 27 percent

The U.S. Bureau of Labor Statistics prepares forecasts for all occupations. These are available online at <http://www.bls.gov/search/ooh.asp?ct=OOH>.

## A Vision for the Future

Houston County High School (Warner Robins, GA) recently implemented a pilot one-to-one Tablet PC program with 28 ninth-graders randomly selected from the general, gifted and special education populations. The students were divided into two groups - one group was given laptops the other was not.<sup>10</sup>

When the pilot ended, results showed that students working on the Tablet PCs had far superior computer skills and produced better work, supporting the conclusion that students with Tablet PCs are better prepared for their future education. High school officials could say they were helping students achieve the overall goal of having the technology skills to prepare them for post-secondary education and to enter the 21st century workplace.

Houston County High School is winner of the "Schools of Distinction Award," a program administered by the Blue Ribbon Schools of Excellence Foundation in cooperation with Intel and Scholastic. This program highlights successes of the best schools in the United States, celebrates their effective use of technology, demonstrates the benefits of strong teamwork, and showcases the classroom practices of excellent teachers.

# Section 2. Understanding One-to-One Computing

One-to-one computing simply means "anytime, anywhere technology for every student."

"In the past," *Education World* explains, "a high school history teacher might have had students conduct a semester-long research project. To help with their research, the teacher would schedule time in a computer lab, rotate groups of students on a few classroom computers, or simply expect students to use a home or library computer. Such irregular use of technology did not prove helpful for building students' technology skills or for successfully integrating technology into the classroom."

On the other hand, students using wireless laptops or Tablet PCs in one-to-one computing situations "have constant and immediate technological access to the entire digital world. Their teachers can address teachable moments immediately, break down classroom walls, and engage students in real world learning. Students can take the technology with them throughout the day, continuing their schoolwork at home, on a riverbank, in a waiting room, or even at the mall."<sup>11</sup>

Continuous access to the tools for writing, doing research online, organizing work, making presentations and other essential skills is a fairly recent development, and the demand for 24/7 technology is growing. The "personalization" of computing tools for all students and teachers is dawning throughout the United States and across the globe. And all the major technology providers have one thing in common: they all promote universal one-to-one access to technology.

## Guidelines for Successful Technology Initiatives in K-12 Schools<sup>12</sup>

### **From The President's Committee Of Advisors On Science And Technology (1997):**

- Focus on learning WITH technology, not ABOUT technology.
- Emphasize content and pedagogy, and not just hardware.
- Give special attention to professional development.
- Engage in realistic budgeting.
- Ensure equitable, universal access.
- Initiate a major program of experimental research.

## Seven Action Steps from the National Education Technology Plan (2004):

- Strengthen leadership.
- Consider innovative budgeting.
- Improve teacher training.
- Support e-learning and virtual schools.
- Encourage broadband access.
- Move toward digital content.
- Integrate data systems.

## Tools for the Digital Age

According to MIT's Joseph Jacobson, a laptop computer holds the answer to many of today's challenges. Such a portable tool is something a child could not only work with, but also feel empowered by. With laptop computers, students can access thousands of textbooks electronically and collaborate with any number of other students.<sup>13</sup>

Students may also develop their own software or attach cameras, microphones and a printer to the laptop to create a personal laboratory for interactive innovation, a tool perfectly synchronized with their different interests and talents. "Given the right equipment," suggests Jacobson, "every individual has the potential for a distinct contribution."

See Joseph Jacobson's article, "What If Every Kid Had a Computer?" Wired Magazine 13.04 (April 2005). <http://wired-vig.wired.com/wired/archive/13.04/view.html?pg=2>

The media lab "dream" isn't entirely without precedent. Now in its third year, Maine's first-in-the-nation middle school program<sup>14</sup> puts laptops in the hands of more than 34,000 students and teachers. Where there's a vision, schools or communities, even in the poorer areas of the country, can make this "dream" come true.

*The Maine Learning Technology Initiative (MLTI) is the largest educational technology project in the history of Maine and perhaps the world. Maine stands as the first state to embark upon a plan to eliminate the digital divide by providing a laptop to each and every seventh- and eighth-grade student and teacher.*

**Vision:** *The vision behind MLTI is very simple: to provide the tools and training necessary to ensure that Maine's students become the most technologically savvy students in the world. With the change at both the national and state level to an economy and society that focuses more on knowledge and intellectual ability instead of brawn and manpower, it is imperative that a major part of all students' education focus on developing these skills.*

"Windows on Maine" is a Web archive of video clips, photographs, interviews, documents, and other materials that teachers and students can access and use for teaching and learning. Available at: <http://windowsonmaine.library.umaine.edu/>.

## Tablet PCs — the Next Step Up

A plan for “one-laptop to one-child” should provide Internet-ready and multimedia-capability to children inside and outside of the classroom, making computing as ubiquitous as cell phones. Implementing Tablet PCs is most likely the next level of engagement in one-to-one programs. It provides a user interface that is as easy as a pen and pencil and makes it extremely easy to embed computers into the curriculum. Its benefits position the Tablet PC as the probable next-step up in the future of portable, wireless computing. Microsoft Corporation lists 10 top benefits of the Tablet PC:

### **Top 10 Benefits of the Tablet PC in Education:**

- Use One of the Most Advanced Operating Systems
- Work from Anywhere with One of the Most Mobile PCs Ever
- Take All Your Notes Electronically
- Use Ink Anywhere, Anytime
- Record Lectures and Presentations Using Linked Audio
- Personalize Your Experience
- Let Your Voice Do the Work
- Get More Done in Less Time
- Help Protect Critical Data
- Deploy and Manage Easily

For more information see: <http://www.microsoft.com/windowsxp/tabletpc/evaluation/bymarket/education/toptenbenefits.mspx>

## One-to-One Computing Installations

In a press release at the time of the launch of the National Education Technology Plan (January 2005), the U.S. Department of Education noted, “The explosive growth of online instruction and virtual schools (in many states) is already complementing traditional instruction with high quality courses tailored to the needs of individual students. At least 15 states provide some form of virtual schooling to supplement regular classes or provide for special needs, and about 25 percent of all K-12 public schools now offer some form of e-learning or virtual school instruction.”<sup>15</sup> In the same press release, U.S. Department of Education estimates that within the next decade every state and most schools will be doing so.

### **Statistics:<sup>16</sup>**

- The ratio of students to computers in all public schools in 2003 was 4.4 to 1.
- 48 states included technology standards for students in 2004-2005.
- 8 percent of public schools in 2003 lent laptop computers to students. In those schools, the median number of laptop computers available for loan was 5.

- Schools in rural areas (12 percent) were more likely than city schools (5 percent) and urban fringe schools (7 percent) to lend laptops.
- 10 percent of public schools in 2003 provided a handheld computer to students or teachers.
- 16 states had at least one cyber charter school operating in 2004-2005.
- 22 states had established virtual schools in 2004-2005.

One-to-one initiatives already dot the U.S. map. Here are some examples that provide a look into what's being done and how much has been achieved so far.

“The ultimate goal is to be able to see exactly the kind of lesson a particular student needs based on his or her portfolio of work and other measures — including many that incorporate teacher judgment — and then to be able to browse for exactly the kind of lesson the student should do next, and send it straight to that student's laptop.”

— Pat Lavallee,  
principal,  
TEMS

### Thomas Edison Middle School — “A Program with a Broad Vision”<sup>17</sup>

“It's not just the boxes,” Thomas Edison Middle School Principal Pat Lavallee told *Education World* magazine (2005). “It's not just learning Windows and some applications. In this school, we're trying to build for the kids a society where people do the right thing.” In TEMS' one-to-one program, kids also learn about responsibility: “Each kid knows that the other kid is carrying around an expensive piece of technology.”

The school wants to move toward electronic portfolio assessment, “making it possible through technology to achieve a far more nuanced picture of each student's abilities, while at least approximating the efficiency of standardized testing.”

“The ultimate goal is to be able to see exactly the kind of lesson a particular student needs based on his or her portfolio of work and other measures — including many that incorporate teacher judgment — and then to be able to browse for exactly the kind of lesson the student should do next, and send it straight to that student's laptop.”

When *Education World* asked about her hopes for the program, Jennifer Slifer, one of the teachers involved in the sixth-grade laptop rollout, said “This is going to bring the real world into the classroom.” Students are “spending more time on task . . . ‘Current events’ were suddenly very current.”

“Teachers' instructional styles began to move away from the ‘sage on the stage’ mode and more toward the ‘guide on the side’ approach.” Most importantly, the students felt more connected to their school and more authenticated in their learning experience.

The full *Education World* story of the Thomas Edison Middle School (Meriden, Connecticut) is at: [http://www.educationworld.com/a\\_tech/tech/tech213.shtml](http://www.educationworld.com/a_tech/tech/tech213.shtml). The school's Web site is: <http://www.aces.k12.ct.us/tedison/>.

### Shattuck St. Mary's School —Improving Communications

To improve communications and create a digitally connected community, Shattuck St. Mary's School, a private boarding school in Minnesota,<sup>18</sup> provided Gateway notebook computers to each of its sixth- through 12th-grade

students. Shattuck students are international, so they have unique needs when it comes to communication. Since all students have a laptop and e-mail accounts and instant messaging, they can communicate with parents and parents can communicate with faculty and staff.

## **Benefits of Wireless at Shattuck St. Mary's School**

### **Communications**

- Improved communication with parents, who can log on to “Net Classroom” and view their child’s conduct, attendance, and grades.

### **Productivity**

- Enabled mobility for student athletes and administrators who travel, keeping them productive and in communication while on the road.

### **Academics**

- Shift from a teacher-centric approach to a student-centric environment.
- Consistent utilization of technology in the classroom.
- Improved motivation of students on campus.

For more information see “Schools Elevate Student Learning Experience through Wireless Technology,” an IDC White Paper Sponsored by Gateway (2003), available at: [http://www.gateway.com/work/docs/edu /gtw\\_ed\\_paper\\_072303.pdf?cmlid=work/ed/k12/success.shtml](http://www.gateway.com/work/docs/edu /gtw_ed_paper_072303.pdf?cmlid=work/ed/k12/success.shtml).

## **Watertown, South Dakota**

This northeast South Dakota district consists of nine schools and educates over 4,000 K-12 students. As the world becomes more reliant on technology, district leaders wanted to use technology to help meet the objectives set by the district’s mission statement — to enable students to succeed in an ever-changing world. Watertown also set forth objectives to:

- Help its students develop 21st century skills. By creating a learning environment around visual literacy and digital collaboration, the district felt its students would be more prepared for college and their future careers.
- Narrow the digital divide.
- Improve communication throughout the whole district by integrating a global e-mail system and a dynamic Web site that students could access on a daily basis.

With these three main objectives in place, the Watertown School District named the project “Learning with Laptops” and began its one-to-one laptop initiative with 1,400 students and 85 teachers in the fall of 2003 and has built from there.

As Brad Brandsrud, Assistant Principal for Watertown High School and the former Notebook Project Manager, explains, “We know that many

families have PCs at home but there was a concern about being able to access the school's network from home. By integrating a wireless notebook program — putting a notebook in the hands of each student — we could give them better access.

“A typical day begins with students coming to school, getting on the district's Web site to read the latest announcements, checking their e-mail and chatting with friends via instant messenger to see if they have arrived for the day. When class begins, the teacher typically asks them to check their e-mail for information from that teacher or to open Discourse®, a student comprehension and participation software program. Teachers can see each student's screen to monitor his or her work without walking from student to student.”

In a single year, Watertown has created complete collaboration in the classroom by placing Gateway wireless notebooks in the hands of its students. The quality of research papers has improved with easy Internet access and the convenience of typing responses instead of handwritten papers. One student used the knowledge he gained from a PowerPoint® lesson and created multiple “Jeopardy” games that were put on the district's Web site for students and teachers to play when they had free time. “Something that had once been an assignment — creating PowerPoint presentations — was now being applied toward making something fun. That just proves that our notebook initiative is working,” Brandsrud summarized.

Today, the latest technology is available 24/7, helping the students at Watertown develop 21st century skills. The students and teachers work on wireless notebook computers to create a completely interactive learning environment. The laptop initiative powerfully engages students, attracts and helps retain high-quality teachers, streamlines administration and encourages parental involvement. But, say local officials, “All it takes is the right combination of technology, products and services.” Watertown's Web site is: [http://watertown.k12.sd.us/schools/srhigh/learning\\_with\\_laptops.htm](http://watertown.k12.sd.us/schools/srhigh/learning_with_laptops.htm).

## Tuscarora School District

Located in south central Pennsylvania, the Tuscarora School District educates approximately 2,700 K-12 students, in four elementary schools, a middle school and a single high school. As a rural area, the district has relied on secondhand technology from a neighboring district. According to Superintendent Dr. Thomas Stapleford, “Time just seemed to forget about Tuscarora. The general feeling of the community was that technological advances would probably never happen here.”

When he became the superintendent at Tuscarora in 2003, Stapleford realized the need for new technology at the district. At the time Tuscarora was running a variety of applications on a variety of platforms. “Our middle school was using a different application for attendance and paperwork than our high school, and our elementary schools used yet another application.”

The district needed to update hand-me-down PCs, add mobile solutions including wireless access across buildings and improve its overall network.

“We know that many families have PCs at home but there was a concern about being able to access the school's network from home. By integrating a wireless notebook program — putting a notebook in the hands of each student — we could give them better access.”

— Brad Brandsrud,  
assistant principal,  
Watertown High School

Updating to comply with No Child Left Behind became the number-one priority for the superintendent. Tuscarora needed new technology to help the faculty and staff improve student performance.

Today, every teacher in the district carries a Gateway notebook PC, providing robust mobile connectivity. The software allows teachers to take attendance, create curriculum plans online and access a profile of each student instantly. Teachers can customize curriculum for each student. The 350 notebooks allow teachers to better monitor students; which in turn, helps increase the district's compliance with NCLB.

Administrators use a notebook-to-Tablet PC to conduct classroom observations. They can enter a classroom and quietly take notes using a digital pen. The administrator can also complete a write-up with the pen, convert the evaluation to type at the push of a button, print and hand it to the teacher right after the lesson. This process saves the administrator and teacher valuable time.

Thanks to an online bulletin board, board members can stay up-to-date on school activities and communicate with the superintendent on a daily basis: "I have one board member who is 75 years old and had never touched a computer — now he's doing all of his board tasks, and e-mailing me on his notebook. Nobody thought I could get him to use a computer and now he is."

Tuscarora has transformed from having very little technology to relying on the latest technology to handle daily tasks. From each teacher using a notebook PC to students learning on the go with a new mobile lab — Superintendent Stapleford believes his district has come full circle and can better serve the students of Tuscarora Schools.

## State of Maine

The Maine Learning Technology Initiative (MLTI) has helped "transform Maine into the premier state for utilizing technology." The program is based on the vision of former Gov. Angus King, and an initial legislative appropriation of \$37 million. Maine's public schools enroll about 207,000 students in grades K-12. The state has implemented a program that provides laptop computers for all seventh- and eighth-grade students and teachers. For a complete program description, go to: <http://www.state.me.us/mlte/>.

In Maine, the Mitchell Institute found daily student attendance improved from 91 percent to over 98 percent in one year and 48 percent of parents reported their children are more motivated now that they work with laptops.

The full report is available at [www.mitchellinstitute.org/research/finallaptopreport.doc](http://www.mitchellinstitute.org/research/finallaptopreport.doc).

## Henrico County School District

In this large Richmond, Virginia school district, 100 percent of the district's schools now meet Virginia's full accreditation standards. This major accomplishment is compared to 70 percent when the district's one-to-one

"I have one board member who is 75 years old and had never touched a computer — now he's doing all of his board tasks, and e-mailing me on his notebook. Nobody thought I could get him to use a computer and now he is."

— Dr. Thomas Stapleford, superintendent, Tuscarora School District

laptop program began three years ago. Last year students realized a 13-point gain, the highest average scores in the district's history. Not only are more students learning and learning better, the district has experienced substantial cost savings on calculators, periodicals, maps and reference books — all of which are available by notebook computer on a 24/7 basis. Some ESL students have been using their laptops at home to help teach their parents English. The Henrico County Public Schools enrolls almost 43,000 students in grades K-12. And middle and high school students have laptop computers.<sup>19</sup>

The Henrico County Public Schools Web site is: <http://www.henrico.k12.va.us/ibook/>.

## Other Larger One-to-One Computing Initiatives

The following list is compiled from several sources, including the official Web sites of states and school districts identified.

**Henrico County:** See this EDC and SRI Research Web site: [http://main.edc.org/newsroom/features/edc\\_sri.asp](http://main.edc.org/newsroom/features/edc_sri.asp).

**Connecticut** – Gov. M. Jodi Rell in 2005 proposed a \$15.5 million initiative to the state Legislature to purchase laptops to improve high school students' writing skills. About 19,000 laptops would be provided to ninth- and 10th-grade students. See: <http://www.eschoolnews.com/news/showStoryts.cfm?ArticleID=5524>.

**Texas** – June 2004, Technology Immersion Pilot (TIP) Grant Program – More than 7,000 laptops have been distributed in Texas at 13 schools. The immersion project is funded with \$12 million from a federal Title II grant. Grants totaling \$3.7 million have been awarded to the 13 schools. The individual grants range in size from \$200,000 to \$800,000. See: <http://www.tea.state.tx.us/press/techimmersion.html>.

**New Hampshire** – In January 2004, seventh-graders at six schools received laptops in a four year pilot – Concord, NH: former Gov. Craig Benson officially launched a new era in education when he delivered laptop computers to all seventh-graders at the six schools across New Hampshire. See: [http://nhpr.org/view\\_content/5148/](http://nhpr.org/view_content/5148/).

**New Mexico** – The governor's program for seventh-graders is based on the successful Maine Learning Technology Initiative. Findings in Maine show that the initiative has dramatically increased technology use and competency in classrooms. Each of the six exploration sites will be evaluated on how the computer access affects three core areas: 1) teachers and teaching, 2) students and learning and 3) school and community perceptions. These criteria are also the focus of the Maine study, so New Mexico will be able to compare results. The cost for each laptop is \$1,128, including grade- and curriculum-specific software. See: <http://www.sde.state.nm.us/press/2004/jan/1.14.04.htm>.

**New York** – \$30 million for Innovation grants, including but not limited to one-to-one laptop pilot programs for students of high need who are at risk of not achieving New York learning standards. At this writing, the pending legislation appears to have support of both houses and the governor's office.

**Iowa** – The Iowa Legislature created legislation to establish a state level Commission and begin one-to-one pilots. At this writing, House File 739 has been signed by Governor Vilsack.

**Louisiana** – Governor Blanco is considering a recommendation from the “Louisiana Laptop Task Force” to begin a pilot program.

**Florida** – April 2004, The Laptops for Learning Task Force report recommended equipping students with laptop computers. The task force report and related stories can be found at: <http://etc.usf.edu/L4L/Index.html>  
[http://www.bradenton.com/mld/brad\\_entonherald/8417454.htm](http://www.bradenton.com/mld/brad_entonherald/8417454.htm).

## Evaluating Key Findings

### Research Findings

#### Henrico County

“An overwhelming majority of teachers and students in six through 12th grades in the Henrico County public school district reported positive impacts of using laptop computers,” according to a study released in May 2005 by SRI International and Education Development Center, Inc.<sup>20</sup> “With 25,000 laptops provided to students and teachers, the Henrico County program is the largest one-to-one computing initiative in any district in the U.S.” Key findings<sup>21</sup> at Henrico County include:

- 97 percent of mathematics and science teachers reported that the computers have helped students to learn these challenging subjects.
- 59 percent report that laptops have helped “a lot” or “a great deal.”
- Teachers report that laptops have had “positive” or “very positive” impacts on gifted students, students with learning disabilities, and typical students alike.
- More than 80 percent of students reported that using a computer for their schoolwork is “helpful” or “very helpful.”

Teachers report that the computers have had “positive” or “very positive” impacts on students’ engagement and interest levels, the teachers’ interactions with students, and on students’ ability to work independently.

“The survey results and site visits we conducted in Henrico County provide strong evidence that the initiative is working to strengthen teaching and learning of mathematics and science in the district,” said Raymond McGhee, Ph.D., the research scientist at SRI International who directs the study.

SRI International, an independent, nonprofit research institute, is coordinating a consortium of organizations and professionals to develop a common framework for evaluating the implementation and outcomes of ubiquitous computing (state and district laptop and handheld computer initiatives), focusing especially on K-12 mathematics and science education.

## Project Hiller

The Education Development Center's Center for Children and Technology (CCT) conducted a three-year (1998–2001) evaluation of Project Hiller,<sup>22</sup> a National Science Foundation-funded project in Union City, New Jersey. The school district gave network-enabled laptop computers to 110 incoming freshman students, 70 of their teachers, and administrators at the urban high school.

The survey results and site visits we conducted in Henrico County provide strong evidence that the initiative is working to strengthen teaching and learning of mathematics and science in the district.

— Raymond McGhee,  
Ph.D.,  
research scientist,  
SRI International

### Project Hiller – Key Findings

- **Created a cadre of technologically sophisticated students.** “Contributed to making technology use a central element of the school, and fostered students who became a technical-support resource for teachers and peers throughout the building.”
- **Improved relationships between students and teachers.** “Demonstrated a visible and positive impact on teacher-students relations. As one teacher explained, ‘Project Hiller is more than technology. It is self-reliance, group work and teacher responsibility. What students need is mentoring and belonging. That is the answer to school reform.’”
- **Made technology more central to core teacher practices.** “As a programmatic requirement of Project Hiller, teachers and students worked together in teams to complete project activities such as producing PowerPoint presentations and developing the school Web site, which initiated a series of project-based work.”
- **Increased student performance and outcomes on traditional measures.** “Standardized test scores rose significantly for Project Hiller students across all tracks. Analysis of ninth-grade scores for Cohort 1 indicated no difference between participants and their peers prior to Project Hiller, however, by years 2 and 3 of the project, participating students scored significantly higher than their non-Project Hiller peers. For example: within the honors track in specific regard to math scores, Project Hiller students scored 414.05 on the New Jersey State High School Proficiency Test (HSPT) versus 396.14 scored by their non-Hiller peers.”
- **Increased enrollment of high achieving eighth-grade students in the high school.** “The possibility of participation in Project Hiller encouraged high performing eighth-grade students to stay in the public school system. In the year prior to Project Hiller (1997-1998), Union Hill enrolled just 38 ninth-grade honors students, while in 1998–1999, the first year of the program, Union Hill drew 44 freshman students into its honors program. In the second and third year of the project, Union Hill admitted 59 and 55 students into the ninth-grade honors program respectively, representing a 25 percent increase from 1998 in the number of high achieving eighth-graders choosing to enroll at the high school.”
- **Demonstrated the benefits of portable, 24/7 computing.** “The combination of portability and wireless connectivity has made the laptop a highly visible demonstration tool, and one easily shared among students for a variety of academic tasks such as Internet research and

PowerPoint. Portability created the potential for proving, impromptu training sessions by Project Hiller students as they shared technical knowledge; students were frequently found teaching their teachers and peers in the media center, in the cafeteria, or in class. One administrator reported an increase in students sharing not only their laptops but also their technology knowledge ... they seem to be more connected to the media center and engaged with the curriculum. Additional research findings regard changes in teacher beliefs and student products, the role of mentoring, access, and the impact of technology on the family.”

- **Researchers’ Conclusions.** “Aligned with the objectives of the larger district, this program’s purpose was to push for a climate of high expectations. Project Hiller met its initial goals because the design and implementation of the project gave students substantial responsibility and autonomy in relationship to technology and their learning. Our findings suggest that when technology is deliberately used as thoughtful support for educational reform in a school, a complex set of interactions can occur that help make improvement possible.” (The Education Development Center’s Center for Children and Technology (CCT). See: [http://www2.edc.org/CCT/publications\\_report\\_summary.asp?numPubId=129](http://www2.edc.org/CCT/publications_report_summary.asp?numPubId=129)).

## Computers and Student Conduct

The findings of a study examining the impact of computers on student conduct in Florida also found that fewer “conduct violations” occurred and fewer disciplinary actions were taken.<sup>23</sup>

## Writing Using Computers Versus Paper and Pencil

Another study comparing K-12 students writing with computers and students using paper and pencil found that “on average students who use computers when learning to write are not only more engaged and motivated in their writing, but they produce written work that is of greater length and higher quality.” (The effect of computers on student writing: A meta-analysis of studies from 1992 to 2002. Goldberg, A., Russell, M., & Cook, A. (2003). *The Journal of Technology, Learning, and Assessment*, 2(1). Retrieved October 7, 2003 from <http://www.bc.edu/research/intasc/jtla/journal/v2n1.shtml>).

## “Improved Writing Skills” says Researcher

Students who have used laptops also have better writing skills. On a writing assessment “laptop students’ writing rated stronger in all four scored areas: content, organization, language/voice/style, and mechanics.” (Rockman, et. al., “A More Complex Picture: Laptop Use and Impact in the

One administrator reported an increase in students sharing not only their laptops but also their technology knowledge ... they seem to be more connected to the media center and engaged with the curriculum.

– Project Hiller

Context of Changing Home and School Access,” the third in a series of research studies on Microsoft’s Anytime, Anywhere Learning Program).

## Technology Integration and Home-to-School Connections

Technology integration programs designed to improve home-to-school connections typically result in:<sup>24</sup>

- A modest increase in student reading ability.
- A substantial increase in student writing ability.
- A modest increase in student mathematics ability.
- Significantly improved communications between parents and school.

## Computers and Math Achievement

In an attempt to determine the relationship between computer use and fourth- and eighth-grade students’ mathematics achievement, data from the 1996 National Assessment of Educational Progress showed that higher mathematics scores were related to adequate access to computer technology (hardware, software, and overall infrastructure) in conjunction with teachers trained in how to use computers to teach new, higher-order concepts.<sup>25</sup>

## Instructional Strategies

Other studies also provide information demonstrating that instructional strategies and teacher use are important considerations. According to a study by Middleton and Murray (1999), the level of technology used by the teacher significantly affected student academic achievement in mathematics in a comparison of fourth- and fifth-grade teachers and their students.<sup>26</sup>

“Developing the ability to learn independently, collaborate with peers to accomplish work, and communicate the conclusions for your work are the core of 21st century skills, and a highly valued set of competencies in the world outside of school,” writes Saul Rockman, in *Learning from Laptops* (Fall, Threshold Magazine, 2003). <http://www.ciconline.org/AboutCIC/Publications/threshold.htm>. Also see: <http://rockman.com/articles.htm>.

In the Beaufort County, South Carolina Evaluation of the Middle School Laptop project, results show “Tests for significant difference were calculated comparing the NCE scores of laptop users and non-users on reading, math, and language sub-tests. In all instances, the average scores of the laptop users were higher than those of the non-users, and the differences were statistically significant.” See: Kenneth R. Stevenson, Department of Educational Leadership and Policies, University of South Carolina, at: <http://www.beaufort.k12.sc.us/district/ltopeval.html>.

Laptop students’ writing rated stronger in all four scored areas: content, organization, language/voice/style, and mechanics.

— Rockman, et.al.

## What Other Studies Show

Although technology continues to change and evolve, all the research seems clear on one point: Routine access to technology will increase learning in environments where educational expectations have been communicated. In addition to the traditional “student achievement” measures, students with access to technology “develop 21st century skills”:<sup>27</sup>

- Improved basic skills (math, writing)
- Improved digital age literacy skills (technological, cultural, global awareness)
- Improved inventive thinking skills (creativity, problem solving, higher order, sound reasoning)
- Improved effective communication and interpersonal skills (writing, public speaking, teamwork, collaboration)
- Improved productivity skills (create high quality products)

The CEO forum offers a series of reports for those who are considering both plans and research-based approaches. See: <http://www.ceoforum.org/reports.html>.

According to Anita Givens, Senior Director of Instructional Materials and Education Technology, Texas Education Agency, “Here are some exciting findings after just one year after launching a one-to-one program:

- *“The students are coming to school early, they are also at the school grounds on the weekend.”*
- *“After the rollout, attendance is up – in both teachers and students. Many schools reported 100 percent attendance two weeks after the rollout.”*
- *“Student engagement is way up.”*
- *“Many parents are now coming to the school to learn about the technology on the weekends. They are using it to apply for jobs and younger members of the family are excited and getting involved too.”*
- *“Discipline referrals have dropped 60 percent to 70 percent – across many of the schools.”*
- *“Most often, discipline referrals happen during lunch or breaks; now, instead of getting in trouble, students are engaged with the technology.”*

# Section 3. Leadership and Readiness

## Before Initiating a One-to-One Program

In American schools, using both top-down and bottom-up strategies are effective in technology decision-making, especially where both teachers and administrators have initiated technology innovations.<sup>28</sup> From the point of view of a learning organization,<sup>29</sup> it is most important that teachers and administrators share vision and work collaboratively. Technology directors and their staff are also critical to accomplishing successful one-to-one computing initiatives.

## Strategic Planning Checklist

When getting ready to initiate a one-to-one program consider the following checklist recommended by Gateway:<sup>30</sup>

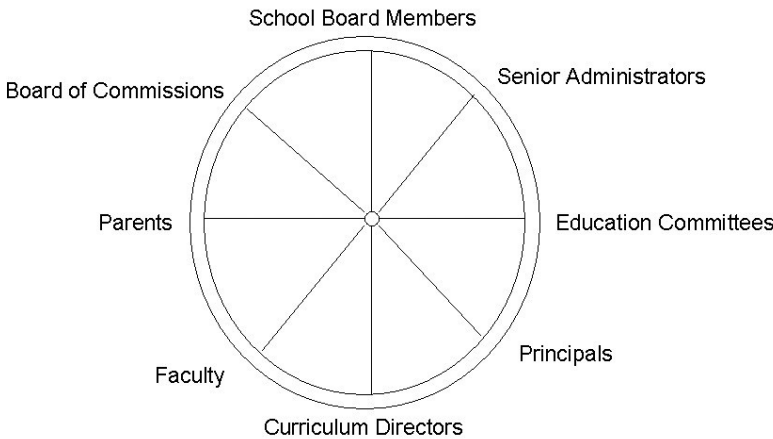
- Establish a task force.
- Get recommendations about program plan from technology vendors.
- Develop a plan for gradually distributing equipment and automating the process as much as possible.
- Establish a wireless network with complete coverage and enough access points to handle the load. This is far less expensive than installing fiber optics or copper wire, and with similar bandwidth speeds.
- Standardize everything: hardware, software, Internet access, browser and e-mail. Make sure a standard “image” or software download is included on each notebook, so that set up and recovery is simple.
- Be aware that models and hardware technology change quickly. Don’t select outdated hardware.
- Have power options: extra batteries, extra chargers and quick hook-ups in class.
- Explore the option of becoming an authorized service center and having the tech vendor reimburse you for repairs.
- Provide teachers with their laptops months in advance and provide adequate training on hardware and instruction integration. This will greatly help reduce IT help time and associated costs.
- If improved assessment results are your goal, establish benchmarks before deploying the laptops.
- Run a small-scale pilot for one year before school or district-wide deployment.
- Start simple — leave the more difficult educational applications for later use when confidence is high.

- Have a plan for cycling aging computers out of the program through purchase by students or via the lease. Another option may be an asset recovery program from the vendor, which disposes outdated notebooks in an environmentally friendly way and provides a credit toward a new purchase.
- Arrange for a low-cost ISP for families without Internet access or plan to subsidize if necessary.
- Do not underestimate the need for technical support for students and staff.
- Develop a comprehensive plan for backing up files and teach student the importance of backups.

This checklist is adapted from “One-to-One Laptop Initiatives: Providing Tools for 21st Century Learners,” a strategy paper with insight from the Center for Digital education and underwritten by Gateway. To access the paper go to: <http://www.gateway.com/work/ed/k12/success.shtml?clv=TB>.

Nearly all of those moving forward with wireless LANs indicate that their IT departments are involved in the planning, which would be expected. Beyond that critical group, others — faculty, students, school administrators — should “buy in” and be involved, with various people initiating the planning process.

During all phases of planning and implementation, communicate with all stakeholders — faculty and staff, students, parents and the community.



For a successful implementation, local policy leaders usually consider the following actions.

## Developing a Shared Vision – Administrative Leadership and Support

Learning Point Associates (NCREL) tells the “success story” of New Technology High School in Napa Valley, California. The school provides “a model of successful community collaboration,” says Learning Point.<sup>31</sup>

With help from more than 45 business partners, a large parent group, and the ongoing involvement of students working as interns in local businesses, New Tech has created an opportunity for the whole community “to develop technology skills, explore new careers, and attract major companies that recognize the possibilities New Tech provides for mutual benefit through exciting new partnerships.”

“It took business community leaders and Napa district staff four years of planning to create New Tech, a school “that would enable its graduates to truly ‘hit the ground running’ in the digital age.” The process was “financed with grants, donations, and pro bono business contributions – but fueled by equally important and ongoing contributions of time, advice and ideas.” As Learning Point Associates describes its progress, “New Technology High School is truly implementing a vision for learning in the 21st century.”

Read more about New Tech High School online:

[http://www.newtechhigh.org/School/about/about\\_default.asp](http://www.newtechhigh.org/School/about/about_default.asp).

The first of NCREL’s “Guiding Questions” for local planners is, “What is your vision of learning?”<sup>32</sup> “Successful education reform of any kind,” says NCREL, “is driven by a broadly held and forward-thinking vision for learners. A strong vision articulates clear and compelling learner characteristics or outcomes, and usually articulates the optimal characteristics of the organizations seeking to produce that change.” When developing a forward thinking vision NCREL recommends a “pre-assessment” asking:<sup>33</sup>

1. “Do your school-community stakeholders understand how technology is shaping 21st century cultural norms?”
2. “Do your school-community stakeholders understand how technology can assist schoolwide improvement and academic achievement?”
3. “Do members of your technology-planning committee know how to conduct a comprehensive needs assessment using a collaborative community process?”

The vision for technology should be a clear, concise picture of the future that the guiding coalition has collectively developed and widely communicated. Consider the following technology standards for school administrators.

Technology Standards for School Administrators (TSSA) prepares principals, administrators and other school or district leaders to lead in a technology-rich learning environment. Leaders:

- Inspire a shared vision for effective use of technology for teaching and learning.
- Describe latest cornerstone education technology research and how it applies to standards-based performance assessment.
- Evaluate their role as a leader in a technology-rich learning environment.
- Ensure the school-based support structures are in place for maximizing teaching and learning with technology.
- Evaluate teachers’ use of technology to support the implementation of standards-based performance assessment in the classroom.
- Identify methods for measuring how use of technology affects student learning to support the implementation of standards-based performance assessment.

With help from more than 45 business partners, a large parent group, and the ongoing involvement of students working as interns in local businesses, New Tech High School has created an opportunity for the whole community.  
– NCREL

- Model the use of technology to access, analyze and interpret data to improve student learning.
- Describe the social, legal and ethical issues in using technology in the classroom.
- Enhance their personal technology proficiency skills.
- Fulfill the TSSA standards.

See: [http://cnets.iste.org/administrators/a\\_stands.html](http://cnets.iste.org/administrators/a_stands.html) and <http://cnets.iste.org/> for a full listing and review of the standards.

## Communicating the Vision

Research indicates that senior administrators are highly influential participants who drive the vision for one-to-one technology. Communicating goals for a wireless initiative is critical, and creating committees, task forces and councils will provide leadership for communication strategies. Communicating the vision may be comprised of:

### Policy Components

- Define expectations and organizational components.
- Define vision and goals.
- Establish and identify policy, plans and budget.

### Coordination Components

- Establish project management including development, documentation, coordination and maintenance.
- Develop communication strategies.

### Implementation Components

- Direct the strategies to implement and provide feedback from stakeholders.
- Set up services and delivery, day-to-day activities, operations and functions such as help desk, procurement and communications.

### Develop a Consistent and Coordinated Communications Plan

- Support integration of initiatives.
- Provide technology training and professional development for staff
- Develop funding strategies.
- Establish public/private partnerships.

For more policy resources see the NSBA toolkit resources: <http://www.nsba.org/sbot/toolkit/PolSrc.cfm>.

For an online technology resource for school board members, go to: <http://www.nsba.org/sbot/toolkit/>.

Visit Intel's Web site for a basic primer on Wired or Wireless: [http://www.intel.com/personal/do\\_more/wireless/wifi.htm?iid=ipc+wireless\\_tools\\_wiredvswireless&](http://www.intel.com/personal/do_more/wireless/wifi.htm?iid=ipc+wireless_tools_wiredvswireless&).

Also see Getting Unwired at: [http://www.intel.com/personal/do\\_more/wireless/going.htm?iid+ipc\\_wifi\\_body\\_goingwireless&](http://www.intel.com/personal/do_more/wireless/going.htm?iid+ipc_wifi_body_goingwireless&).

For more information on WAN's and LAN's go to: <http://www.intel.com/business/bss/industry/education/higher.htm>.

## Faculty Support and Professional Development

A key component of any instructional technology planning includes staff development or professional development that provides opportunities for demonstrating relevant pedagogical approaches. Surveying faculty for a better understanding of their own perceived needs — from technology skills to awareness and use — will help determine the type and level of development that may be needed.

Including faculty in all phases of wireless initiatives from planning to implementation will ensure more successful programs. For some schools, faculty endorsements may be necessary and may include a “faculty vote” in early adoptions. Pilot programs may also serve as demonstration projects and capture faculty enthusiasm that can be leveraged to other schools across an entire district.

## Teaching Centers for Professional Development

A number of campuses have created technology-related Teaching Centers that provide faculty a place to meet for formal and informal professional development opportunities. Incentives for integrating technology have included either computers (laptops) or stipends/grants for developing content (online, courses, etc.) or both depending upon the school's needs and financial capabilities. Some faculty opt to have a wireless portable computer instead of a desktop, valuing versatility and the option to take the computer or Tablet PC home for true 24/7 availability.

Creating sustainable professional development opportunities is an important consideration and should include opportunities for early adopters of one-to-one computing to become coaches and mentors to their peers. It is also important that faculty become as self-sufficient as possible and have information available online for just-in-time delivery.

“Effective staff development focuses on the knowledge, skills and attitudes required of teachers, administrators, and other school employees so all students can learn and perform at high levels. Staff development not only includes high-quality, ongoing training programs with intensive follow-up and support but also other growth-promoting processes such as study groups, action research, and peer coaching, to name a few.” The National Staff Development Council, online at: <http://www.nsd.org/connect/about/faqs.cfm>.

Staff development not only includes high-quality, ongoing training programs with intensive follow-up and support but also other growth-promoting processes such as study groups, action research, and peer coaching, to name a few.

— National Staff Development Council

## Learning Resources for Teachers and Students

The Intel® Innovation in Education Web site contains resources designed to improve the effective use of technology in the classroom. Some resources, such as Intel's collection of exemplary Unit and Project Plans, help teachers plan standards-based instruction that uses technology. Others, such as the thinking tools, are designed for teachers and students to use during learning projects. To help teachers use any of these resources to the fullest potential, Intel has provided an Online Resources Guide to help the professional developer or technology integration specialist build customized presentations about these free resources. See at: <http://www.intel.com/education/guide/index.htm>.

The Center for Children and Technology, part of Education Development Center <http://www2.edc.org/CCT/> (EDC/CCT) conducted an independent evaluation of the 2004 Intel® Teach to the Future Leadership Forum pilot (January 2005): [http://www2.edc.org/cct/publications\\_report\\_summary.asp?numPubId=193](http://www2.edc.org/cct/publications_report_summary.asp?numPubId=193)

Also, see TERC, a not-for-profit education research and development organization, supporting professional development for Educators: <http://www.terc.edu/TEMPLATE/about/index.cfm>.

The *LearnWithGateway* professional development program offers an array of instructor-led courses covering such topics as: maximizing the use of computer technology in the classroom, getting the most from your Tablet PC, and training based on faculty's choice of products. For details, go to [www.learnwithgateway.com](http://www.learnwithgateway.com).

## Developing a Communications Plan

A solid communications plan will greatly benefit the transition to one-to-one computing. Faculty, students, parents and the community at large should be informed of all stages of planning and implementation. For example, it is recommended that school district leaders:

- Inform parents that their child will be using a laptop.
- Invite parents and students to an orientation meeting (that's truly an exciting time for students to get their hands on the laptops for the first time).
- Explain that this mandatory meeting provides students and parents an opportunity to ask questions, sign acceptable use policy documents, collect insurance fees, identify a set of homework items and Web sites, and share other information. Be sure, however, to make accommodations for families who cannot attend.
- Provide demonstrations at the meeting on how to care for the computer, including charging, cleaning and various care and use tips including how to carry the laptop. Provide each student a carrying case if they will be allowed to take the laptop home.
- Discuss rules and regulations and distribute handouts to each parent and child along with an FAQ on expected care of the equipment.

According to Dr. Mike Hall, Deputy Superintendent of Information Technology, Georgia Department of Education, “A community relations program that educates the public is imperative to any laptop initiative. Because the average citizen may have a hard time seeing the value of a one-to-one program,” Hall states, “the following questions must be answered to accomplish buy-in from the community:

- *“What is the instructional value of the project? The project must be about changing instruction as opposed to buying computers.”*
- *“What about access at school and security?”*
- *“How will the technology be sustained in the future?”*
- *“How will you support the movement?”*
- *“Will students have 24-hour access to the computers or just at school?”*

Dr. Hall added, “It’s a good idea to put together a task force comprised of stakeholders and provide them with the leadership and support to plan, initiate, and drive a public relations effort. And all of this must be done before sending out the initial RFP.”

“A community relations program that educates the public is imperative to any laptop initiative.”

– Dr. Mike Hall,  
Deputy Superintendent  
of Information Technology,  
Georgia Department  
of Education

# Section 4. Requirements for Successful Initiatives

## Careful Planning

To implement a well-designed, well-executed one-to-one laptop initiative, consider these five fundamentals: the computer, network connectivity, security, training and support, and project implementation.

The rising market demand for smart personal objects such as cell phones integrated with PDAs and pocket and Tablet PCs means that the desire for increased portability with greater functionality will only intensify for both current and emerging technology consumers. Thorough planning, testing, evaluating, diagnosing, and correcting — integrated into the design for a network solution — offers the greatest assurance that the technology deployment and use will be successful.

Many peer school districts are willing to share the lessons they have learned through guidance and plan documents that are freely available. In some cases hardware or application-hosting service providers offer start-to-finish assistance with entire packages that bundle hardware and software solutions.

## Equipping One-to-One Computing Classrooms

The most essential piece of a successful technology project is of course the computer and the array of software applications bundled with it. A needs-based survey of student and faculty requirements and desires provides the best way to determine the most appropriate hardware and software configuration, including the computer's overall dimension and weight, screen size, processing speed, memory and connectivity.

Students who use higher-end software applications and access Internet sites that feature video streaming will have greater computer hardware requirements than students who primarily use word processing, spreadsheet or presentation applications, send e-mail, and access basic Web sites. It is important to evaluate how the computers will be used inside and outside the classroom and the degree to which computers can be integrated into the curriculum.

Also consider the ages and grade levels of the students who will use the laptops and the teaching activities that will be involved. Introducing laptops into only one or two classes requires a different configuration than laptops used across a student's entire course load. The number and type of peripherals can add flexibility and functionality to any laptop, regardless of its config-

Typical minimum technical requirements would include at least a three-year warranty, the current vendor-recommended maximum hard drive and memory sizes, built-in wireless cards, a built-in CD-ROM drive, one or more USB ports (for jump drives and other devices) and a battery that can last at least two hours.

uration, but peripherals also increase the overall cost. Finally, it is important to know if the computers can be upgraded two to three years following deployment. Upgrading the operating system, hard drive and optical drive are significant aspects of keeping the technology current with new consumer preferences and applications to maintain optimum functionality in the classroom.

Microsoft Windows Anywhere 2005 provides a good example, at: [http://www.microsoftwindowsanywhere.com/virtual/materials/mwa/30\\_pulsipher.pdf](http://www.microsoftwindowsanywhere.com/virtual/materials/mwa/30_pulsipher.pdf).

Another example is provided by Deloitte Research – Creating a Mobile Enterprise in the United States (2003), at: [http://www.mda-mobiledata.org/MDA/pdfs/deloitteresearch/mobile\\_data\\_us.pdf](http://www.mda-mobiledata.org/MDA/pdfs/deloitteresearch/mobile_data_us.pdf).

## Network Connectivity and Infrastructure

Wireless laptops or Tablet PCs demand a network of easily accessible resources — from the classroom printer to the World Wide Web — and the key to access is connectivity. A professionally plotted array of appropriate wireless access points will ensure that faculty and students will have the information they want, when and where they want it.

The following information is compiled from several sources including an article by Cary Hellman, College Park High School, Pleasant Hill, California, and Matt Hiefield, Sunset High School, Beaverton, Oregon on “Considerations for Purchase and Implementation of Mobile Laptop Labs.” See: [http://www.intel.com/education/emergingtech/mobile\\_laptop\\_labs.htm](http://www.intel.com/education/emergingtech/mobile_laptop_labs.htm).

The school’s technical staff will need to assess on a continuing basis not only the utilization of the individually assigned laptops but also the school’s core computer infrastructure, including its network and server. Server-based tools should be available to allow support technicians to easily remove obsolete applications and install new programs.

As the network grows and the need for greater and faster connectivity becomes apparent, additional licenses and servers may be necessary. Rack-mounted servers that are in close proximity to technical staff offices should be considered. Server maintenance, support, and training are all critically important aspects of system reliability that will encourage the use of technology in the classroom.

When faculty and students have uninterrupted use of technology they will be more likely to find additional ways to apply new and innovative technologies to traditional approaches to teaching and learning. On the other hand, if computer infrastructure is not maintained and adequately supported, and system outages and failures become common occurrences, the classroom customer will be forced to bypass the promising potential of one-to-one technology and resort to past practices that excluded digital tools.

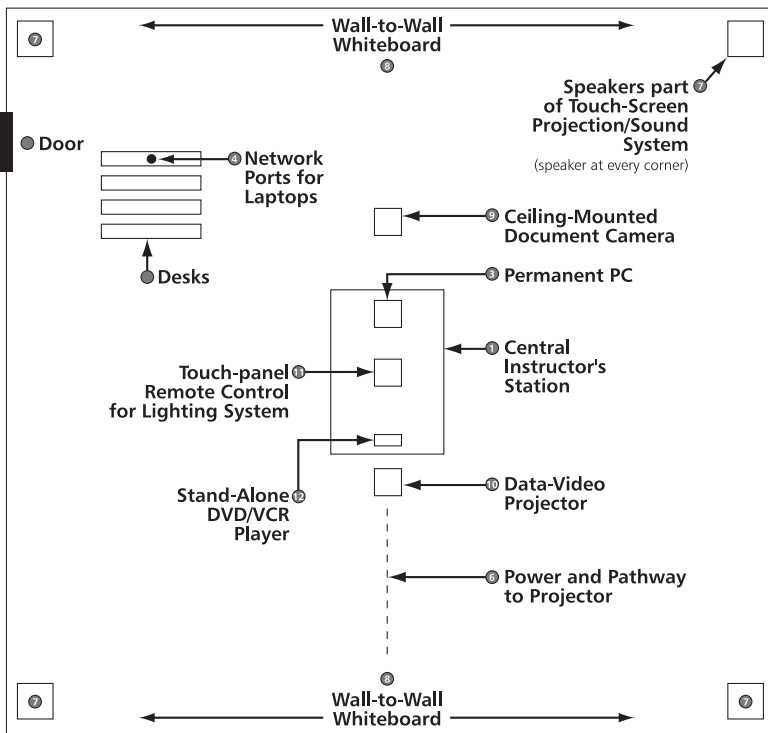
Network performance can be optimized under the right conditions, such as fiber optic backbone, high quality routers and switches, a high-speed broadband connection, ample access points, and efficient and reliable servers. Network design, configuration, maintenance and operation and

troubleshooting should all be part of a comprehensive plan that is developed to introduce and vigorously support classroom applications and student access of today's computer technology.

In summary:

- Each wireless access point needs to provide connectivity for between 10 and 30 laptops (depending on model and configuration) based on the IEEE 802.11 standard.
- Each access point must be tested for both indoor and outdoor signal strength. The signal's outdoor parameter is an important consideration for campuses that have multiple buildings or a central commons.
- Vendors should assist in evaluating and assessing wireless capabilities and help institutional staff in developing the access point installation plan.

### Example – Equipping the Intelligent Classroom



### Curriculum Integration and Professional Development

Schools might consider creating a variety of technology tracks to address the unique needs and demands different faculty will face in the classroom. Furthermore, faculty should be provided laptops well in advance of a pilot

program or full-scale implementation so they can become familiar with the hardware and software, develop their course content, and receive necessary support to accomplish their pedagogical goals.

Ongoing professional development should be the goal to help faculty integrate technology into their professional practice. "For example, most administrators and faculty easily see the connection between computer technology and math and science courses, but some may need assistance in relating technology to English, history, and the arts."<sup>34</sup>

## Curriculum Integration

As important as professional development is for successful technology initiatives, perhaps nothing is as important as curriculum integration. Hardware and software must be seamlessly woven into the course content; that is, integrating one-to-one technology into classroom instruction and student learning outcomes requires that the technology be an essential part of what and how students discover, interpret, relate and remember. And because curriculum integration is a paramount objective in one-to-one initiatives, the convergence of technology and teaching and learning is also the foremost challenge schools face when launching laptop programs.

Fortunately a number of professional development programs exist that focus on classroom technology and curriculum integration. For example, the Pennsylvania "Link to Learn Project" devotes an entire Web site to helping teachers learn how to use technology in their classes. See: <http://205.146.39.13/>.

"Faculty Technology Mentoring Programs: Major Trends in the Literature," provides a valuable list of references and information that should help most schools design effective programs. "The elements include providing visions for technology use, individualizing technology support, breaking down the hierarchical structure, establishing open dialogue and collaborative relationships, and providing mutual benefits for mentors and new teachers." See: [http://www.public.iastate.edu/%7Emstar/mentor/Technology\\_mentoring0128.htm](http://www.public.iastate.edu/%7Emstar/mentor/Technology_mentoring0128.htm).

## Professional Development Standards

Professional development standards include Federal Title II legislation "Enhancing Education Through Technology," which makes explicit the importance of aligning professional development with challenging state and local standards. Also Title I of ESEA requires each state to have adopted challenging content standards in at least reading and mathematics and challenging performance standards that describe students' mastery of the content standards.

The National Educational Technology Standards profiles for technology-literate teachers "correspond to four phases in the typical preparation of a teacher."

- General Preparation
- Professional Preparation
- Student Teaching/Internship
- First-Year Teaching

These profiles can be found at: [http://cnets.iste.org/teachers/t\\_profiles.html](http://cnets.iste.org/teachers/t_profiles.html).

## Online Professional Development Resources

- T.H.E. Institute offers a variety of professional development opportunities for educators. From the publishers of T.H.E. Journal. <http://www.thejournal.com/institute/>
- WebEd offers self-guided, self-paced courses on educational topics to K-12 teachers and administrators. <http://www.webed.com/>
- Atomic Learning online tutorials through a library of thousands of short, easy-to-view and understand movies that can be used as an integral part of a professional development program, a valuable curriculum supplement, and an anytime, anywhere software training resource. <http://www.atomiclearning.com/>
- OnlineLearning.net provides numerous online learning opportunities for educators, including topics related to instructional technology. <http://www.onlinelearning.net/>
- eLearningDepot.com offers online training for a wide variety of computer applications, including skill sets for desktop computing and business skill development. <http://www.elearningdepot.com/>
- Barnes and Noble University offers courses on a wide range of topics, many of which can be taken for Continuing Education Units (CEUs). Some free courses are offered. <http://university.barnesandnoble.com/index.asp?nhid=bn>
- Training Café – Macromedia offers interactive courses and tutorials related to Macromedia products as well as on some education-related topics. <http://www.trainingcafe.com/>
- Learning.com offers EasyTech, a complete online instructional system that enables today's K-8 educators to successfully integrate technology with core curriculum. <http://www.learning.com/>
- Concept to Classroom offers workshops on various educational topics on this award-winning professional development site. Topics include WebQuests, Inquiry-based learning and multiple intelligences. Concept to Classroom at <http://www.thirteen.org/edonline/concept2class/>
- Connected University is an online professional development community sponsored by Classroom Connect, providing educators with courses, learning resources, just-in-time support, and a convenient way to interact with peers nationwide. <http://www.cu.classroom.com/logon.asp>

## Insuring the Laptops

Experience shows that if the district chooses to own the computers, most risk insurance programs can provide districts with a policy rider that will cover the laptops. Parents will need to sign release forms prior to their students taking the laptops home since most homeowner policies will provide coverage for damage or loss. Students who cannot afford the insurance fee can be considered for a waiver if they qualify for a district's free and reduced lunch program.

Many computer vendors provide accidental damage protection programs or extended warranty opportunities for the computers they sell to schools. These services can either supplant or supplement any insurance coverage the district already has in place for computer hardware.

Lockable carts with built-in power capability with surge suppressors for up to 30 laptops would be an excellent investment when the laptops are at school but not in use or in the assigned student's possession.

Some school districts have established an insurance fee that parents pay for their child to use the laptop. For one-to-one initiatives, this fee is charged annually and should cover the costs for repair and/or replacement. Again, these fees and the insurance coverage should be developed with assistance from school finance personnel and school attorneys.

## Technical Training, Support and Maintenance

Most hardware and software providers offer a range of technical services and products to assist schools in maintaining the technology infrastructure they deploy. Perhaps most significant of these services is technical training for school IT staff. This training is especially important for institutions that choose to develop their own self-service repair capacity.

For school districts that rely on outside vendors for repair, it is important for technical staff to know how to diagnose and verify problems that require vendor intervention. Limiting system downtime is extremely important in a world that operates in a 24/7 environment. Today, most vendors provide help desk and online technical support services offering basic assistance to both support staff and end users.

A separate parts agreement should be considered in relationship to the length of the program and the terms of the lease agreement. Warranty agreements should be carefully evaluated to ensure that institutional needs are adequately addressed. More importantly, warranty provisions need to be thoroughly communicated to faculty and staff so they recognize how the repair and replacement limitations relate to their personal responsibility over the laptops assigned to them. Finally, larger-scale projects may prompt the vendor to dedicate professional and engineering consultants to the project for long-term support.

# Section 5. Financing a One-to-One Initiative

The Consortium for School Networking (CoSN) provides guidance on how to talk about costs through its “Taking TCO to the Classroom” project. The project “provides school leaders with tools to help them estimate the Total Cost of Ownership (TCO) involved when they build a network of computers and wire their classrooms to the Internet. ‘Ownership’ in this context includes all of the costs associated with using and maintaining networked computers, no matter whether a school district owns or leases them.” The project is described online at: <http://classroomtco.cosn.org> and <http://optin.iserver.net/fromnow/mar03/truecost.html>.

The KickStart Initiative, a community-based organization bringing “the Information Superhighway to all individuals through schools, libraries, and community centers,” suggests that technology costs fall into these categories:

- *Reprogramming or re-allocating funds* could come from textbook expenditures and re-focusing those on multimedia courseware, online instructional materials, software, and instructional support. (Some districts have re-allocated their textbook funding to their one-to-one initiatives and secured subscriptions to such vendors as Beyond Books.com and/or language learning software.)
- *Alternative funding mechanisms* include general obligation bonds, revenue bonds or state lottery funding.
- *Cost savings* include planning for wireless implementations rather than dedicated labs in new construction by reducing the need for a wide variety of lab equipment and network connections.

The previous topics are references at the top of the Web page for the Kick Start Initiative: <http://www.benton.org/publibrary/kickstart/kick.identifying.html#measures>.

According to Lemke and Martin, “Henrico County, Virginia, has designated between 4 percent and 5 percent of its budget to the program over ten years” (Lemke & Martin, 2004). “The county negotiated home Internet access rates and parents pay an annual insurance fee for theft, loss and/or damage.” ([http://www.mcrcel.org/PDF/PolicyBriefs/5042PI\\_PBLaptopInitiative.pdf](http://www.mcrcel.org/PDF/PolicyBriefs/5042PI_PBLaptopInitiative.pdf))

## Funding Considerations

Summarizing the technology initiatives, school districts nationwide have used a variety of funds, including: state general aid, local education funds, renovation funds, federal title funds, and some have used funds raised privately in their communities. As referenced earlier, funding sources are high-

lighted in the Maine Web site: <http://www.maine.gov/education/edletters/2005/ilet/05ilet007.htm>.

For a public or non-public school district, evidence from one-to-one programs shows that district procurements are accomplished by purchasing, leasing, or lease-purchases. The total investment should include hardware, software, professional services and support that include technical support and warranty and repair, professional development, and project management. Uniformity of software applications and imaging will also make things easier for technical support.

### **Considerations for financing include:**

- Financing through tuition or fees.
- Operational budgets.
- Institution-owned or leased equipment including replacement and/or upgrades, negotiated typically on two, three or four-year cycles (leases are becoming prominent).

Some districts have solicited their project funding through local foundations. Businesses and individuals may contribute money to a foundation, and if a 501(c)(3) entity, the donation becomes tax deductible.

The flexibility that leasing offers regarding acquiring laptops/Tablet PCs has allowed many school districts to implement one-to-one programs. This allows the school to budget and plan for yearly expenditures over “x” number of years rather than try to come up with the entire program funding upfront. Leasing also allows schools to better plan how to manage the “end of life” of the product by providing options.

School leaders should communicate with the community at large in a variety of informal and formal settings to answer questions about why a district is investing in a one-to-one computing initiative.

Getting business and community leaders to help “sponsor” and support these initiatives can often develop stronger relationships between the school and the community and demonstrate a project that will affect student learning.

School foundations may be a source of local funding that helps to secure outside private funding, although private funding usually only accounts for approximately 3 percent of any public school contributions.<sup>35</sup>

## **Funding Strategies**

Funding Strategies for one-to-one laptop initiatives may include:

- **Operating budget(s) and reallocations** – in the case of Henrico County, VA,<sup>36</sup> approximately 5 percent of its annual operating budget was re-allocated to its initiative.
- **Student Fees** – as in higher education, both public and private institutions make initiatives possible through student fees as part of their learning experience – similar to “textbook fees” software for curriculum content might be included in such fees.
- **Incentives** – by leveraging grants and public dollars, private business and individuals are more likely to contribute to a school foundation program dedicated to an initiative.

School leaders should communicate with the community at large in a variety of informal and formal settings to answer questions about why a district is investing in a one-to-one computing initiative.

- **Grants** – technology solutions can be integrated into most grants as a means to achieve goals; technology should be considered in any 21st century learning grant. Each state and/or community will have different business or philanthropic organizations. Be sure to review the grant criteria before applying and contact the program officers prior to submitting any grants. For more information, see the Foundation Center Web site: <http://fdncenter.org/>.
- **State/Federal Legislative appropriations** – approximately a dozen states with legislation have created appropriations for one-to-one initiatives.
- **Local option taxes or levies** – school districts use leveraging of local option taxes or levies for school improvement and student achievement, or bond issues that allow for technology upgrades for a portion of the hardware and networking.
- **Local business or other private funding** – the national average for private contributions range from approximately 2 percent to 3 percent, therefore business and corporate or community foundations may also be a source of funding, but in most cases, will not be a primary source of funding.<sup>37</sup>

## Federal Funding

The National Education Technology Plan for the U.S. Department of Education provides some guidance on funding and action steps for procuring educational technology.

The U.S. Department of Education recommends, “Needed technology often can be successfully funded through innovative restructuring and reallocation of existing budgets to realize efficiencies and cost savings. The new focus begins with the educational objective and evaluates funding requests – for technology or other programs – in terms of how they support student learning. Today, every program in No Child Left Behind is an opportunity for technology funding — but the focus is on how the funding will help attain specific educational goals.”

School Funding Services released a series of reports describing all funded programs in NCLB and the law’s flexibility provisions for states and school districts. Their report “State and Local Flexibility Options in ESEA” is available free on their Web site. The “ESEA Reference Guide: Program Descriptions and Funding Levels,” which includes funding levels by program and state, is available by request at: [www.schoolfundingservices.org](http://www.schoolfundingservices.org).

## Federal No Child Left Behind Funds (NCLB)

This program provides financial assistance through state educational agencies (SEAs) to local educational agencies (LEAs) and public schools with high numbers or percentages of poor children to help ensure that all children meet challenging state academic content and student academic achievement standards.

LEAs target the Title I funds they receive to public schools with the highest percentages of children from low-income families. Unless a participating school is operating a schoolwide program, the school must focus Title I services on children who are failing, or most at risk of failing, to meet state academic standards. Schools enrolling at least 40 percent of students from poor families are eligible to use Title I funds for schoolwide programs that serve all children in the school.

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### Title I, Part A Program

This program:

- Reaches about 12.5 million students enrolled in both public and private schools, and may be used for children from preschool age to high school. Most students served (65 percent) are in grades 1 through 6; another 12 percent are in preschool and kindergarten programs.
- Supports state and local school reform efforts tied to challenging state academic standards to reinforce and amplify efforts to improve teaching and learning for students farthest from meeting state standards. Both schoolwide and targeted assistance programs must be based on effective means of improving student achievement and include strategies to support parental involvement.
- Provides services for eligible private school students, as well as eligible public school students. Section 1120 of Title I, Part A of the Elementary and Secondary Education Act (ESEA), as amended by the No Child Left Behind Act (NCLB), requires a participating LEA to provide eligible children attending private elementary and secondary schools, their teachers, and their families with Title I services or other benefits that are equitable to those provided to eligible public school children, their teachers, and their families. For additional information on services to eligible private school children, see the U.S. Department of Education Office of Non-Public Education Web site: <http://www.ed.gov/programs/titleiparta/index.html>.

### Title IIA, Title IID, Title IVA, and Title V

These federal funding sources could also be used in support of the local share. Increased flexibility under NCLB permits local districts to transfer up to 50 percent of allocated funds across NCLB programs (Title IIA, Title IID, Title IVA and Title V). Technology purchases are permitted under each of these categories, but the transfer provision could also be employed to concentrate available funds in one category.

## Leveraging Federal Funds for Technology

The following identifies technology considerations for various federal programs.

### **Title I, Part A**

- Enterprise solutions facilitate data driven decision making; disaggregated data and accountability reporting will require servers, storage and backup, and data mining software.
- Online opportunities for professional development and testing may require new laptops, new curriculum packages may require new computers, and parent and community reporting may require new portals.

### **Title I, Part B: Reading First**

- Web-based and software products - comprehensive reading curriculum (may require updated desktops and servers).
- Supplemental reading products - speech recognition software.
- Handheld reading applications for diagnosis and testing.
- Online training for teachers.
- Reporting and accountability will require servers and storage.

### **Title II, Part A: Preparing, Training and Recruiting High Quality Teachers and Principals**

- Professional development in the integration of technology.
- Online training for teachers.
- Laptops for administrators and teachers.
- Funds may be used for computer hardware such as server and wiring as a follow-up to professional development activities, providing it is part of the district's professional development plan and is the best use of funds.

### **Title III, Part D: Enhancing Education Through Technology**

- Professional development (25 percent).
- Upgraded hardware and software.
- Expansion of electronic networks.
- Technology to promote parental involvement.
- Data warehousing/mining.
- Internet-based services.
- Maintenance and support.
- Computers for teachers.
- Handhelds, PCs and Tablet PCs.

### **Title III: Language Instruction for Limited English Proficient and Immigrant Students**

- ESL, bi-lingual software.
- Reading programs.
- Hardware to support program initiatives.
- Online or on-site training for teachers.
- Internet access for instructional materials.
- Electronic assessment tools.

#### **Title IV, Part B: 21st Century Community Learning Centers**

- Funds may be used for programs such as youth development activities, drug and alcohol prevention, art, music and recreational programs, technology education programs, counseling programs, and character education.

Note: NCLB Title IV Local-Flexibility Demonstration Program allows districts to consolidate federal funds under a five-year plan that outlines areas of improvement. See: <http://www.neirtec.org/flexibility/info/default.asp>.

#### **Title V, Part A: Promoting Informed Parental Choice and Innovative Programs**

- Twenty-seven eligible programs: Funds for curricular materials, professional development and gifted and talented programs — with strong emphasis on technology acquisition, integration and teacher training.
- Emphasis on flexibility and transferability: local districts may transfer up to 50 percent (30 percent for low-performing) of funds among the following and/or Title I:

Title II, Part A - Teacher Quality Training  
Title II, Part D – Tech Grants (formula)  
Title IV, Part A – Safe and Drug-Free Schools  
Title V – Innovative Programs

Note: This is not a transfer of funds from one Title program to another but a transfer of the use of funds.

The United States General Accounting Office (1998) provides a School Technology / Five School Districts' Experiences in Financing Technology Programs Report: <http://www.gao.gov/archive/1998/he98083t.pdf>.

## **State Funding**

Although funding for school technology at the state level has changed over time, several states have maintained some state-level funding that can be leveraged (for example, Florida and Texas). As an alternative, other states are increasing state and local income taxes, general sales taxes, or adding a special sales tax. In other states, initiatives have been piloted and expanded.

In Louisiana, for instance, one county increased sales taxes by 0.5 percent for 3 years and 1 percent for subsequent years for this purpose. Under “Schools,” see: <http://www.benton.org/publibrary/kickstart/kick.identifying.html#funding>.

In Maine’s initiative, as highlighted in the National Education Technology Plan, the seventh- and eighth-grade one-to-one program is funded entirely from state resources, first from a one-time general fund surplus and then as part of the overall education budget. See <http://www.state.me.us/mlte/about/index.htm>.

NEIRTEC, one of the ten regional R\*TECs, has created a series of Technology Briefs for state and local officials that need to implement the Title II, Part D provisions of the NCLB Act. The report is a result of collaboration with Education Development Center, Inc. (EDC), TERC, Education Alliance at Brown University, and Learning Innovations at WestEd. This report responds to the set of requirements for preparing state and local applications including: strategies for improving academic achievement and teacher effectiveness, parental involvement, professional development, and accountability measures. For a copy of this publication, see: [www.neirtec.org](http://www.neirtec.org).

## Key Funding Insights

Based on information provided by educational institutions, government officials, and private industry participants, the key insights about funding technology for K-12 schools are as follows:

- *Costs for Hardware.* The purchase and installation of hardware constitutes the largest upfront cost. Using wireless local area networks could lower this cost.
- *Costs for Teacher Training.* Teacher training and support constitute the largest ongoing cost during the first five years of deployment. The overall cost should decline over time as teachers enter the system with higher levels of skill and as existing teachers gain more experience with the technology. For the near term, however, it is essential that resources be devoted to this category.
- *Costs for Connection.* The cost of connection per se is a relatively small portion of overall expenditures. Schools should consider installing connections that have greater capacity (for supporting multiple users and carrying large amounts of data) than they need today or even project they will need in a few years.

See: [http://www.benton.org/publibrary/kickstart/kick.identifying.html#funding under Schools](http://www.benton.org/publibrary/kickstart/kick.identifying.html#funding%20under%20Schools).

Also see: Exert More Control Over your Students' Achievement by "Flexing" Your Monetary Muscles <http://www.neirtec.org/flexibility/info/GrntCorner0205.pdf>.

Federal Programs. For an application: <http://www.ed.gov/programs/localflex/applicant.html>.

For some additional ideas, see the NSBA: <http://www.nsba.org/sbot/toolkit/FundTech.html>.

# Section 6.

## Additional Resources

### Organizations and Centers

**The Center for Applied Research in Educational Technology.**

<http://caret.iste.org/index.cfm?fuseaction=evidence&answerID=2>

**The National Education Association.**

<http://www.nea.org/technology/index.html>

**The National School Board Association.**

<http://www.spnsba.org>

**NSBA Education Technology “Leadership Network.”**

[http://www.nsba.org/site/page\\_micro\\_nestedcats.asp?TRACKID=&CID=63&DID=195](http://www.nsba.org/site/page_micro_nestedcats.asp?TRACKID=&CID=63&DID=195)

**The North Central Regional Educational Laboratory (NCREL).**

<http://www.ncrel.org/sdrs/thepoint/techtoc.htm>

**Learning With Laptops (home).**

<http://www.learningwithlaptops.com/>

**The Public Broadcasting System (PBS).**

<http://www.pbs.org/teachersource/teachtech/research.shtm>

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[http://www.sri.com/policy/csted/reports/sandt/it/Kulik\\_ITinK12\\_Main\\_Report.pdf](http://www.sri.com/policy/csted/reports/sandt/it/Kulik_ITinK12_Main_Report.pdf)

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## Endnotes

<sup>1</sup> U.S. Department of Education, Office of Educational Technology, *Toward A New Golden Age in American Education: How the Internet, the Law and Today's Students Are Revolutionizing Expectations* (Washington, DC, U.S. Department of Education, Office of Educational Technology 2004). This report, known as "The National Education Technology Plan" is in the public domain and available at:[http://www.nationaledtechplan.org/docs\\_and\\_pdf/National\\_Education\\_Technology\\_Plan\\_2004.pdf](http://www.nationaledtechplan.org/docs_and_pdf/National_Education_Technology_Plan_2004.pdf).

<sup>2</sup> The National Education Technology Plan. Cited herein as Jonathan Vasquez, "Are Schools Ready for Today's Students? A Sneak Preview of the National Educational Technology Plan (NETP)." Keynote panel, annual meeting of the National Educational Computing Conference (NECC), New Orleans, LA, June 20–24, 2004.

<sup>3</sup> The National Education Technology Plan. Cited herein as National Commission on Excellence in Education, *A Nation at Risk* (Washington, DC: U.S. Department of Education 1983).  
<http://www.ed.gov/pubs/NatAtRisk/risk.html>

<sup>4</sup> The National Education Technology Plan.

<sup>5</sup> The National Education Technology Plan. Cited herein as Douglas Levin and Sousan Arafeh, *The Digital Disconnect: The Widening Gap between Internet-Savvy Students and Their Schools* (The Pew Internet & American Life Project, 2002).

<sup>6</sup> The National Education Technology Plan.

<sup>7</sup> The National Education Technology Plan.

<sup>8</sup> The survey is a part of the National Governors Association (NGA) Chairman's yearlong program, *Redesigning the American High School* (Washington, DC: The National Governors Association 2005). Survey results released summer 2005. <http://www.rateyourfuture.org/>

<sup>9</sup> The National Education Technology Plan.

<sup>10</sup> Intel Corporation's case study "Houston County High School Transforms Learning Through Technology."  
[http://www.intel.com/education/schoolsofdistinction/4526\\_houston2.pdf](http://www.intel.com/education/schoolsofdistinction/4526_houston2.pdf)

<sup>11</sup> Lorrie Jackson, "The 411 on One-to-One Computing," *Education World*® (updated December 5, 2004).  
[http://www.educationworld.com/a\\_tech/tech/tech194.shtml](http://www.educationworld.com/a_tech/tech/tech194.shtml)

<sup>12</sup> The list is a compilation of recommendations from the President's Committee Of Advisors On Science And Technology (PCAST) Panel on Educational Technology, "Report to the President on the Use of Technology to Strengthen K-12 Education in the United States" (March 1997), and the National Technology Plan (2004).

<sup>13</sup> Joseph Jacobson, "What If Every Kid Had a Computer?" *Wired Magazine* 13.04 (April 2005). <http://wired-vig.wired.com/wired/archive/13.04/view.html?pg=2>

<sup>14</sup> State of Maine. A description of the Maine Learning Technology Initiative (MLTI) is available at: <http://www.state.me.us/mlte/>.

<sup>15</sup> Available at: <http://www.ed.gov/news/pressreleases/2005/01/01072005.html>.

<sup>16</sup> U.S. Department of Education, Office of Educational Technology, "Educational Technology Fact Sheet" (Washington, DC, U.S. Department of Education, Office of Educational Technology 2004).  
<http://www.ed.gov/about/offices/list/os/technology/facts.html>

<sup>17</sup> Forrest Stone, "Three Keys to Implementing a Laptop Program: Over-Plan, Over-Train, and Over-Support, Education World® (March 2, 2005).  
[http://www.educationworld.com/a\\_tech/tech/tech213.shtml](http://www.educationworld.com/a_tech/tech/tech213.shtml)

<sup>18</sup> Jocelyn Young, "Schools Elevate Student Learning Experience through Wireless Technology, an IDC White Paper Sponsored by Gateway (2003).  
[http://www.gateway.com/work/docs/edu/grw\\_ed\\_paper\\_072303.pdf?cmlid=work/ed/k12/success.shtml](http://www.gateway.com/work/docs/edu/grw_ed_paper_072303.pdf?cmlid=work/ed/k12/success.shtml)

<sup>19</sup> Henrico Public Schools, 3820 Nine Mile Road, Richmond, Virginia 23223.  
<http://www.henrico.k12.va.us>

<sup>20</sup> SRI International and EDC Study of Largest District-Based Laptop Computer Initiative Demonstrates Benefits of “One-to-One Computing” in Schools. (Menlo Park, CA and 20 locations elsewhere: SRI International Offices, Center for Education Policy and Education Development Center). <http://www.sri.com/news/releases/06-22-04.html>

<sup>21</sup> Results from the SRI International and EDC Study were first presented at the National Education Computing Conference (NECC) in New Orleans in June 2004.

<sup>22</sup> Daniel Light, Meghan McDermott and Margaret Honey, “Project Hiller: The Impact of Ubiquitous Portable Technology on an Urban School” (New York: the Center for Children and Technology). [http://www2.edc.org/CCT/publications\\_report\\_summary.asp?numPubId=129](http://www2.edc.org/CCT/publications_report_summary.asp?numPubId=129)

<sup>23</sup> A. E. Barron, K. Y. Hogarty, J. D. Kromery, and P. Lenkway, *Journal of Research on Computing in Education* (1999) 32 (1), 98-107.

<sup>24</sup> W. R. Penuel, et. al., *Using technology to enhance connections between home and school: A research synthesis*. (Washington, DC, U.S. Department of Education, Planning and Evaluation Service, DHHS Contract #282-00-008-Task 1, 2002). <http://caret.iste.org/index.cfm?fuseaction=studySummary&StudyID=420&words=using%20technology&from=search%20Site>  
<http://www.sri.com/policy/ctl/html/synthesis1.html>

<sup>25</sup> See Wenglinisky, H. (1998). Does it compute? The relationship between educational technology and student achievement in mathematics. Princeton, NJ: Educational Testing Service. <http://caret.iste.org/index.cfm?fuseaction=studySummary&StudyID=337&resultSet=395,422,433,168,972,852,357,343,396,411,430,399,429,409,416,431,394,1035,980,407,421,419,406,370,417,386,275,1044,435,354,400,338,403,1065,410,405,334,420,994,418,330,414,401,428,393,933,1024,1011,371,337,404,415>

<sup>26</sup> B. M. Middleton and R. K. Murray, “The impact of instructional technology on student academic achievement in reading and mathematics,” *International Journal of Instructional Media*, 26(1) (1999).

<sup>27</sup> *Key Building Blocks for Student Achievement in the 21st Century: Assessment, Alignment, Accountability, Access and Analysis* (Washington, DC: CEO Forum on Education & Technology June 2001). <http://www.ceoforum.org/downloads/report4.pdf>

<sup>28</sup> Ronald Anderson and Sara Dexter, "School Technology Leadership: Incidence and Impact," *Teaching, Learning, and Computing: 1998 National Survey*, Report #6, Center for Research on Information Technology and Organizations, University of California, Irvine and University of Minnesota. [http://www.crito.uci.edu/tlc/findings/report\\_6/TEXT.html](http://www.crito.uci.edu/tlc/findings/report_6/TEXT.html)

<sup>29</sup> Although the term “a learning organization” is used by many authors, our use reflects our understanding of the term as described by Peter W. Senge, et al., *The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization* (New York: Doubleday 1994).

<sup>30</sup> Center for Digital Education, “One-to-One Laptop Initiatives: *Providing Tools for 21st Century Learners*,” undated.  
<http://media.centerdigitalgov.com/reg2view /OnetoOneLaptop.K12.pdf>

<sup>31</sup> North Central Regional Educational Laboratory and Learning Point Associates, enGauge<sup>®</sup> Resources, “Success Stories: New Technology High School” (Naperville: North Central Regional Educational Laboratory and Learning Point Associates, undated).  
<http://www.ncrel.org/engage/resource/stories/nths.htm>

<sup>32</sup> North Central Regional Educational Laboratory and the Regional Technology Education Center, “Guiding Questions for Technology Planning” (Naperville: North Central Regional Educational Laboratory and Learning Point Associates, 1996). <http://www.ncrtec.org/capacity/guidewww/gqhome.htm>

<sup>33</sup> North Central Regional Educational Laboratory, “Technology Connections For School Improvement: Planners’ Handbook,” (Naperville: North Central Regional Educational Laboratory and Learning Point Associates, 1999).  
<http://www.ncrel.org/tplan/handbook.pdf>

<sup>34</sup> North Central Regional Educational Laboratory, “Critical Issue: Providing Professional Development for Effective Technology Use,” (Naperville: North Central Regional Educational Laboratory).  
<http://www.ncrel.org/sdrs/areas/issues/methods/technlgy/te1000.htm>

<sup>35</sup> United States General Accounting Office, Testimony before the Education Task Force, Committee on Budget, U.S. Senate, “School Technology: Five School Districts’ Experiences in Financing Technology Programs,” (Washington, DC: General Accounting Office, January 29, 1998).

<sup>36</sup> Howard Pitler, Kathleen Flynn, and Barbara Gaddy, “Is a Laptop Initiative in Your Future?” (Aurora, CO: Mid-continent Research for Education and Learning, Policy Brief, September 2004).

<sup>37</sup> United States General Accounting Office, January 29, 1998.



