1 to 1 Learning

A Review and Analysis by the Metiri Group

Different Schools for a Different World

For decades, technology has been the driving force behind globalization, accelerating change and the tremendous economic, social, geopolitical, and cultural shifts of the 21st century. It has profoundly changed life in the United States and around the globe.

Today's adolescents have grown up with technology. On average, 13- to 18-years-olds spend more than six hours a day using digital media. As consumers, they collectively control more than $175 billion annually. As students, they are often disengaged by an education system that hasn't capitalized on the power of today's technologies. Outside of school, they instant message, download and listen to music, compose and send text messages and emails, view television, exchange text messages and digital images via cell phone, browse the web, and play interactive games—all the while multitasking. Such facility with technology should not be mistaken for expertise or literacy with technology. Most students are in woeful need of *conventions of technology prowess*—conventions that will enable them to use technologies expertly as informed consumers, critical thinkers, creative producers, and socially adept and effective communicators.

In the best-selling book, *The World Is Flat,* author Thomas Friedman warns there is "no turning back," reminding us that technological influences have irrevocably redefined our world.[1] Savvy educators agree. In fact, a profound transformation is taking place in many progressive schools across the country. Innovative educators are embracing a bold new catalyst to learning: 1 to 1 computing. The "laptop for every student" concept is changing *how, when*, and *where* students learn. The potential of 1 to 1 learning is maximized in schools where these technology tools are deployed in classrooms characterized by academic rigor, real-word experiences, and high-quality teaching that incorporates research on *how people best learn.*

A Profound Transformation in Learning

What Is 1 to 1 Learning?

By definition, 1 to 1 learning involves one student, one computer, one interactive, personalized learning experience in a wireless environment with anytime access to the Internet. The reality is that 1 to 1 configurations in schools range from laptops checked out to all students 24/7 (24 hours per day, 7 days per week), to classrooms of students using wireless laptops available from mobile carts only during the school day. The most powerful learning from 1 to 1 is realized in the 24/7 configuration, guided by highly qualified teachers and informed parents/guardians.

Why 1 to 1 Learning?

All learning is highly personal. A laptop in the hands of each student builds on that concept. High-tech tools serve as an extension of the students' thoughts and learning process. They provide a place to explore ideas, research questions, test hypotheses, compose thoughts, and come to conclusions—in other words, to learn. Along the way, these tools serve as vehicles for social networking[2] and authenticity,[3] two highly effective accelerators to learning. Social networking via technology can connect students to a broad range of interactivity that sharpens and extends thinking and piques intellectual curiosity. 1 to 1 learning adds authenticity into the mix, enabling students to explore rigorous academic concepts in the context of the world around them.[4] The result? A sense of power and confidence unleashed in students and educators through 1 to 1 learning.

Goals for 1 to 1 Learning

Different schools implement 1 to 1 learning for different reasons. In general, the goals driving most 1 to 1 computing initiatives fall into four categories:

- Improving Student Achievement
- Advancing Digital Equity
- Enhancing Teaching and Learning
- Strengthening Economic Development

A current challenge facing proponents of 1 to 1 learning is in defining success. While educators often cite goals other than student achievement, the formal evaluation of such projects is often based entirely on gains in test scores.

Indicators of Success

No question about it, test scores are important, but most stakeholders agree that they are no longer the only factor critical in the education of today's student. 1 to 1 learning provides a unique opportunity to broaden the dimensions by which student success is measured. Consider, for example, problem solving, critical thinking, visual and information literacy, communication skills, teamwork, and the quality of students' multimedia products. Multiple assessments to measure academic achievement, 21st century skills, and engagement provide new insights into the quality and intensity of student learning.

Results from 1 to 1 Learning

Research data, expert opinion, descriptive studies, and anecdotes from schools all lead to the same conclusions—1 to 1 learning can improve student achievement, advance digital equity, enhance teaching and learning, and strengthen economic development. This research base is only now emerging.

Improving Student Achievement

Reports related to student achievement and 1 to 1 learning are encouraging in the areas of writing and mathematics. Teachers and administrators from 1 to 1 schools report new depths of academic inquiry, researching, and understanding on the part of students. They find that their students are acquiring 21st century skills through 1 to 1 learning. Unfortunately, these 21st century skills are not yet assessed on most high-stakes tests.

Chris Dede, a professor from Harvard University, noted in his new book, *Scaling Up Success*,[5] how important it is that policy shifts with the infusion of an innovation into a system. Educators in 1 to 1 learning are aligning learning to the 21st century. Is it not time for policy leaders to do the same with assessments? To do less is to risk ignoring the full range of accomplishments by today's students.

In analyzing the value of 1 to 1 learning to academic achievement, educators look to three important sources of information:
• Rigorous research studies
• Value propositions
• Expert opinions/best practices

Rigorous Research Studies
Results from the limited number of rigorous studies available on 1 to 1 computing provide solid evidence that 1 to 1 learning can increase student achievement. Conscientious educators will look for replication of these findings prior to full acceptance, but early results indicate the impact of 1 to 1 learning on academic achievement is very positive.

Pleasanton Unified School District, California
Harvest Park Middle School, located in Pleasanton Unified School District, California, established its laptop immersion program in 2001. Launched the first year with just 60 sixth-grade students, the program increased to include 259 in 2003, representing nearly 25 percent of the total enrollment of 1085 in grades 6, 7, and 8, and has since grown slightly each year.

This district is one of the few in the country to conduct a rigorous study on the impact of the 1 to 1 learning experience on student achievement, in comparison with a matched group in the same school. Students involved in the 1 to 1 learning program are representative of the total school population. Analyses of outcome measures collected after participation in the laptop program indicate that students who participated in the program earned significantly higher test scores and grades for writing, English–language arts, mathematics, and overall Grade Point Averages (GPAs).

The teachers in the laptop program focused student use on productivity tools, presentation tools, probes, data analysis tools, and problem solving as they integrated technology across the curriculum. (See charts on page 6.)

Value Propositions
With 1 to 1 learning in place, educators can now implement a broad range of new approaches to learning that are proven by research as highly effective, but have been difficult or expensive to implement on a large scale without technology; for example, authentic learning, complex problem- or project-based learning, or increased use of visual or multisensory tools to aid learning.

Cascade High School, Idaho
Research by Dr. Fred Newmann, a professor from the University of Wisconsin–Madison and a leader in school reform issues, finds that when teachers engage students in homework that is "intellectually stimulating," students' academic achievement increases.[6] His criteria for intellectually stimulating, authentic lesson design includes interest in the student work by some entity outside the classroom, deep inquiry into the targeted academic subject, and knowledge construction by the students.

Many of the 1 to 1 learning initiatives are focusing on problem-based learning and/or authentic learning. A state leader in technology integration, Cascade High School in rural Idaho, uses its Apple 1 to 1 Learning environment to engage high school students in authentic projects, connect with field experts, and even influence public policy. Students in advanced biology have designed wetlands, engineered solutions to save struggling trout populations, and even convinced local ranchers to change how they use land.[7] Their technology breaks the barrier of place and time, enabling them to do authentic, stimulating work in their academic studies, while living in a remote rural area.

Piscataquis Community Middle School, Maine

The 1 to 1 learning environments often reveal to teachers the levels of complexity at which students are capable of operating. For example, students at Piscataquis Community Middle School, Maine, conducted research on cultures from their medieval literature studies. They worked in teams to build interactive web pages to present their findings. Teachers remarked on the students' depth of engagement and commitment to learning and productivity throughout the projects. One teacher referred to students as "multimedia sponges," absorbed in the projects. The engagement was affective, behavioral, and cognitive. Students were engaged by the media, by the cognitive complexity of interpreting poems, by analyzing the historical spread of disease, or by synthesizing information on medieval cultures from multiple web sources. The result: deeper understanding of the literature.[8]

The School at Columbia, New York

Visuals are emerging as important to learners on several different fronts. The most obvious is students' immersion in a highly visual world in which they will need to become informed consumers, communicators, and composers/producers with multimedia technology. Less obvious, but supported by research, is the important role that visuals play in problem solving, thinking, and understanding complex academic concepts.[9] Visuals also serve as an important vehicle for teachers in reinforcing their students' learning.

The School at Columbia in Manhattan finds the visual aspects of the 1 to 1 environment, while critical at all levels, especially important for its younger students. Remarking that all children are born storytellers, teachers at the school watched as their "preliterate" first-graders used iPhoto, iTunes, and iMovie to tell rich and compelling stories as they processed interviews in an immigration project. Impressed by the sophistication of their students' multimedia stories, teachers remarked on how Apple 1 to 1 Learning opens doors through visual learning, not only to students not yet expert in writing, but also to bilingual and dyslexic students. Students used visuals, music, and inventive thinking to convey stories of diversity, challenge, accomplishment, and reflection in the immigration project. The result? Increased communication, improved literacy skills, and deeper appreciation of diversity, along with enhanced learning in the social sciences.[10]

Expert Opinions/Best Practices

Highly respected educational leaders, from hundreds of 1 to 1 schools across the county, are reporting new depths to their students' learning. While not definitive, these descriptive studies, expert opinions, and correlational studies serve as important guideposts in these early stages of 1 to 1 learning innovation.

Peace River North School District, Canada

The School District #60 in Peace River North focused its 1 to 1 learning in the area of writing, citing significant gains in the number of students that reached the top two levels of writing achievement.[11] Overall, student writing assessments showed the greatest improvement in form (i.e., organization). Prior to the Apple laptop program, girls significantly outperformed boys on the district writing assessment. Two years into the project, that gap had disappeared, with the percentage of boys and girls meeting standards at 89 percent and 88 percent, respectively. The district also attributes the 1 to 1 learning program for narrowing the gap between Aboriginal students and the general student population.

> "In our first year of district-wide implementation, we saw student scores improve dramatically with 92 percent of our students meeting provincial education standards for writing, compared with a pretest score of 70 percent."
>
> David Vandergugen, Principal of Technology Services, Peace River North School District

Middle Schools, State of Maine

Prior to rolling out former governor Angus King's 1 to 1 laptop program statewide, Maine established test beds of Apple 1 to 1 Learning in nine Exploration Schools geographically disbursed throughout the state. Student achievement in these nine middle schools started out at the state average. Two years later, researchers reported that achievement scores of students in the same nine schools were significantly higher in science, math, and social studies than those of Maine middle schools that had the benefit of only one year with the laptops.[12] The authors of the study suggest "there is credible evidence that (1 to 1 learning) as a total program may be effective in raising test scores for the nine Exploration Schools."

## Irving Elementary School, Pennsylvania

The McAuliffe Heights program at Irving Elementary School brings Apple 1 to 1 Learning to high-need students in Altoona, Pennsylvania. The iBook computers provided to students across grade levels have resulted in collaboration across grades, with older students mentoring younger students. At one time, Irving Elementary posted the lowest achievement scores in the city. Since the inception of the 1 to 1 program, Irving Elementary has received the Pennsylvania Governor's School of Excellence award for improved test scores.[13]

Pleasanton Unified School District, California

Outcome studies reported positive significant gains in mathematics and literacy by Harvest Park Middle School with students in classrooms involved in 1 to 1 learning in comparison with control groups in the same school and across the district. The findings from this study, which was commissioned by the local school board, resulted in expansion of 1 to 1 learning to additional schools within the Pleasanton Unified School District.
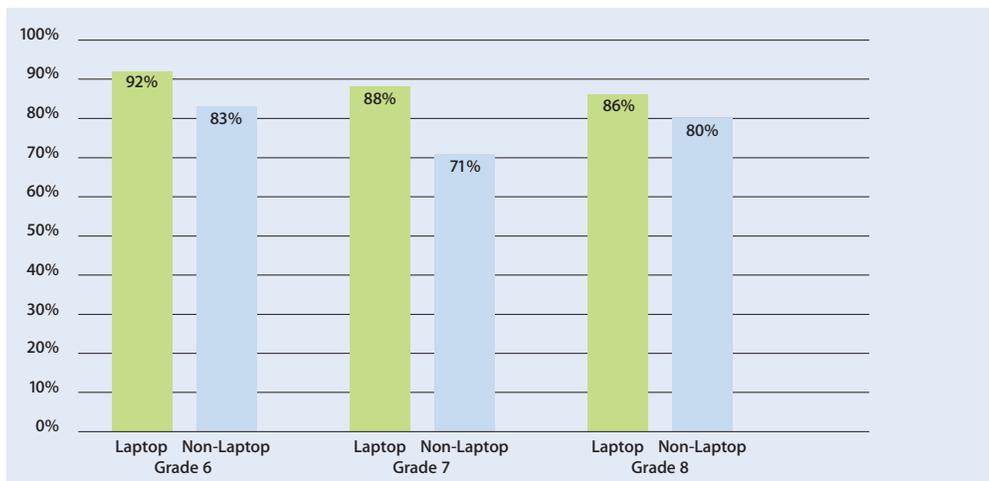
**Harvest Park
Middle School**

2003 STAR California
Achievement Test (CAT/6)

Mathematics scores
after one year of the
laptop program
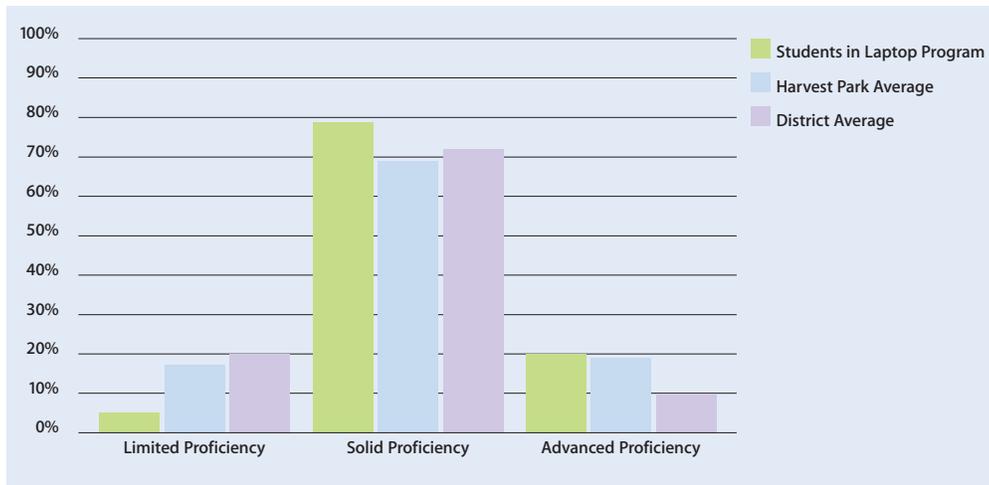
**Pleasanton Unified
School District**

2004 Writing Assessment
by grade and program

After two years of the
laptop program

Advancing Digital Equity

In the 1990s, the digital divide was characterized as a gap in technology access that translated into inequities in educational, economic, social, and civic opportunities among sectors of the population. Since then, education leaders have come to realize that access is simply the first step. Equally important is the readiness of individuals to use technology, communication networks, and information efficiently, effectively, and productively.

A laptop for every student. It sounds like an idea that would appeal primarily to wealthy districts serving more advantaged students. To the contrary, many 1 to 1 initiatives are undertaken specifically to ensure that all students have ready, personal access to today's technology and the world of resources that this access can provide. In a recent review of 1 to 1 computing initiatives conducted by the Metiri Group,[14] over half of the initiatives were implemented in districts serving significant numbers of disadvantaged students. And rightly so, as there is a mounting body of evidence that 1 to 1 learning not only advances the technology skills of individual students, but also, and perhaps more importantly, improves their efficacy as technology users.[15]

This is important as recent research suggests that, though the "Digital Divide" is narrowing in respect to access to technology, it still exists. As of 2002, the Pew Foundation estimated the gap in access to the Internet between high-income families and low-income families to be 48 percentage points, 86 percent to 38 percent, respectively.[16] Further, research has demonstrated that, even where there is a computer in the home, less-advantaged families are likely to be more intimidated by the technology and are less likely to use it as a powerful source for information. In addition, these homes are less likely to have a variety of software on their computers and less likely to have access to cutting-edge technologies such as video editing, sound production, video conferencing, etc. Apple iBook computers provide these tools, always in an approachable, user-friendly format. Software applications such as the easy-to-use iLife suite and iWork can give students the design-oriented tools that they prefer, fostering greater collaboration and communication.

Greene County Public Schools, North Carolina

Another area of concern is a Digital Divide based on geographic location. Rural residents are less likely to have access to technology in the home, less likely to have Internet access, and if they do have Internet access, it is less likely to be broadband. Projects like the 1 to 1 Learning initiative in Greene County, North Carolina, report that the iBook laptops distributed to every middle and high school student in this rural county (2000 total) have had an impact not just on the students, but on entire families.[17]

> "We now have parents who communicate with us via email, check teachers' home pages, and tell us that they feel involved in their children's education in a way that wasn't possible before. And it's not just the parents—the grandparents are online too!"
> Steve Mazingo, Superintendent, Greene County Public Schools

The 1 to 1 initiatives provide a purposeful access to technology that can begin to close the equity gaps in both access and effective use.

Indianapolis Public Schools, Indiana

Begun in 2000, the TechKnow project enabled district leaders to introduce 1 to 1 laptop computing into the schools in urban Indianapolis. At Harshman Middle School, students worked to solve the problem of an abandoned fast-food restaurant across the street from their school—identifying the abandoned property as a potential community problem. They began by constructing and distributing a survey, polling the community about what should replace the building. An analysis of the results revealed that most locals hoped the lot could be turned into a neighborhood pharmacy.[18]

The students took the problem to their math classes, where they researched zoning rules and lot issues, then contacted CVS pharmacies to talk about the square footage and other needs of a typical pharmacy. Finally, they worked with an engineer to design the new structure based on what they learned, all the while considering cost-effectiveness and how the design could best suit the neighborhood. Students used their iBook computers

to project-manage, capture images, and record interviews; edit video for insertion into presentations; produce and analyze the survey results; communicate with experts, their teachers, and their team; and produce a final multimedia report. The result: technology-literate students who understand firsthand, how to make a difference in their community as contributing citizens.

> "If you are in an urban environment … and you are about trying to close or eliminate the achievement gap and equalizing the quality of life for students, you have to think differently about how you educate."
>
> Dorothy Crenshaw, Chief Information Officer, Indianapolis Public Schools

Frontier Middle School, Wyoming

In Natrona County School District in Casper, Wyoming, a new middle school has been created based on an ambitious, multifaceted program for Digital Age Learning. Frontier Middle School features a program grounded in the principles of the Middle School concept, with students helping to develop the essential questions of learning. They then apply 21st century work and technology skills through project-based learning to demonstrate achievement and mastery. In order to implement the 1 to 1 learning program, every student and teacher was provided an iBook, and access to the school network is available 24/7.[19]

Frontier, like all schools in Natrona County, is a school of choice. The students and parents who selected Frontier agreed to enter into the 1 to 1 laptop pilot program, knowing there would be new problems to face. But they also understood they would have the opportunity to be part of the digital revolution that they see and hear about in the media, including instant messaging, iTunes, and personalized desktops. Rather than lock down the iBook computers, the district is allowing students access to these technologies, and focusing on teaching them responsible use. District leaders believe that the act of personalizing the computers has helped students demonstrate greater ownership in their own learning, resulting in higher engagement levels in school.

Enhancing Teaching and Learning

In addition to the emerging evidence of the positive impact of 1 to 1 learning on student achievement, there is significant evidence of the impact that it has on the teaching and learning process. Many of the goals that districts are trying to achieve in bringing more rigorous, authentic learning into the classroom seem to be promoted, almost inadvertently, in classrooms where all students have a connected personal computer. Collaborative learning, rigorous authentic learning, inquiry-based learning, and active, engaged learning are consistently associated with 1 to 1 learning initiatives.

Perhaps the most frequently mentioned goal for implementing any teaching and learning strategy is student engagement. One of the most consistent findings related to student achievement over the past 50 years is that student engagement—often described as a mix of involvement, perseverance, effort, and attitude—is one of the most powerful factors affecting achievement.[20] The impact of engagement on achievement has also been demonstrated to be the same for students at every ability level. While districts are just beginning to generate experimental evidence linking 1 to 1 initiatives to gains in achievement, an increase in student engagement is the most frequently documented outcome in qualitative studies completed on 1 to 1 programs.

> "The seventh- and eighth-graders I work with are finding their own answers more than ever. I have become more of a facilitator and guide, as students pursue their learning and document their discourses. 1 to 1 learning has enabled them to become even more engaged in their learning opportunities. This has been a miracle!"
>
> Ken Williams, Science Teacher, Nobleboro Central School, Maine

Manatee County School District, Florida

Researchers also measure engagement through readily accessible data such as attendance and behavior referrals. At Manatee County Public Schools in Bradenton, Florida, where nearly 6000 students and teachers participate in Apple 1 to 1 Learning with individual iBook computers, the level of student engagement has skyrocketed while absences have declined since the initiative began in 2003. Two-thirds of students report they watch less television and spend more time doing homework. Ongoing "parent night" gatherings keep families and the community informed of the progress of the 1 to 1 initiative.[21]

> "Absences by students who have the iBook laptops have declined by almost 40 percent, while the quality of work done on computer-based assignments has increased dramatically."
>
> Dr. Tina Barrios, Supervisor of Instructional Technology, Manatee County School District

School Administrative District #4, Maine

An analysis of the Apple 1 to 1 Learning initiative in School Administrative District #4 in rural Maine showed that among its middle school children, attendance already relatively high, increased by an additional 7.7 percent, as the district moved from a 3 to 1 to a 1 to 1 student-to-computer ratio. During the same time period, the number of behavior letters sent home decreased by 54 percent. The true measure of this success came when the first students in the program graduated from high school in 2003, setting a new record for the percentage going on to college.[22]

In many of the technology audits that the Metiri Group has completed, one measure used to document the level of technology integration is to look at the "range of use." This range is a comprehensive list of education technology uses that extends from "entry-level" uses such as drill and practice software, word processing, and simple Internet research to more advanced and authentic uses such as simulations and modeling, advanced data analysis tools, and media communication tools. Entry-level uses are important, but technology use in schools often becomes mired in low-level use, and many of the most powerful and academically rigorous uses may not be realized.

In recent studies and evaluations completed on large iBook laptop deployments, the range of technology uses was far more diversified than might be expected. Much of this seems to be due to the availability of easy-to-use tools such as the iLife suite and other Mac OS X features that facilitate more advanced use. There is significant evidence that once these higher-order, more authentic uses become commonplace, gains in achievement and in 21st century skills will follow.[23]

Strengthening Economic Development

According to the U.S. Department of Labor, "We are living in a new economy—powered by technology, fueled by information, and driven by knowledge." Top economists attribute our increasingly stable economy to the flexibility of global markets, economic dynamism, and increased productivity due to technology, all of which are dependent on a highly educated, high-tech, 21st century workforce.[24]

To compete successfully in this global economy, students must be inventive thinkers, self-directed learners, and effective communicators—tech-savvy and digitally literate.[25] The entrepreneurial successes and continued viability of such companies as Google, eBay, E*Trade, Apple, and Amazon are testimony to the opportunities afforded to those who employ 21st century skills.

With the forewarning that "today's education system faces irrelevance unless we bridge the gap between how students live and how they learn," leaders across the country are calling for a new emphasis on 21st century learning.[26] The 1 to 1 learning environment is intended to bridge that gap—to ensure that graduates can compete in a global, knowledge-based economy.

The 1 to 1 learning programs contribute to economic development in two important ways. First and foremost, it reengages disenfranchised, at-risk students in academic studies that lead to advanced degrees—degrees critically important in a knowledge economy.[27] A 30-year longitudinal study by the U.S. Department of Education found that a key predictor of whether young people will earn a bachelor's degree is their participation and completion of a strong academic curriculum in high school, not their actual test scores.[28] Thus, the increase in the rigor, depth, and authenticity of the curriculum through 1 to 1 initiatives can be a positive contributing factor to the student's economic future. Research on 1 to 1 learning finds that the student-to-computer ratio matters, with 1 to 1 learning programs getting significantly better results.

The second critical contribution of the 1 to 1 learning environment is the engagement of students in everyday use of high-tech tools in problem solving, communication, resource acquisition, and data analysis—critical foundations for future knowledge work. A study in Germany found that students using 1 to 1 computing showed higher gains in technology literacy (Internet skills, common productivity tools, etc.) than students from a control group.[29]

Early indicators suggest that students in these 1 to 1 learning programs do have higher degrees of technology literacy and, as a result, have a much higher confidence level in their technology abilities as they enter higher education and the workforce.

The State of Maine
The driving force behind Maine's statewide laptop initiative was economic development. Former governor Angus King remarked, "As I talk to businesses, the biggest thing that they look for is qualified people. … We've got a lot of small towns, a lot of people whose parents didn't go to college, and a relatively low number—about 20 percent—of our people have college degrees. My job as a leader is to try to look out into the future, see what's necessary, and then equip my people with whatever it is. This proposal is for every school, every kid, rich, poor, north, south, east, west, rural, and urban. At a stroke, it would begin the elimination of the division between the technological haves and the have-nots."[30]

King created a public firestorm that eventually resulted in the first statewide 1 to 1 laptop initiative: 38,000 iBook laptops were distributed, one to every seventh- and eighth-grade student and their teachers. Through that initiative, Maine is investing in its most important natural resource—the intellectual capital of its students, with the expectation that this investment will result in a knowledge-based workforce that will attract high-tech industry.

Piscataquis Community Middle School, Maine
Consider previously mentioned Piscataquis Community Middle School, a 1 to 1 learning pioneer that served as a "poster child" for former governor Angus King prior to the enactment of the laptop legislation.

Located in Guilford, an economically depressed mill town, this innovative school implemented Apple 1 to 1 Learning for all middle and high school students and their teachers. The laptop program was launched in 1999 through funds from Guilford of Maine, a woolen mill that, at the time, was in the process of transitioning to robotics for its spinning and weaving. As a result, the company was in search of a workforce ready for intensive teamwork, mathematical problem solving, and high tech.

Profiled by CNN, ABC *World News Tonight,* and the *Bangor Daily News* for its rigorous academic standards, Piscataquis Community Middle School has set high standards for its graduates as effective communicators, self-directed learners, creative and practical problem-solvers, responsible involved citizens, collaborative and quality workers, and informed, integrative thinkers.

Conclusion

As so eloquently conveyed in *The World Is Flat,* there is no turning back. New technologies will constantly emerge—and with them will come social, political, educational, and civic change. 1 to 1 learning ensures that students will be ready to seize such opportunities confidently, intelligently, and with social conscience.

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