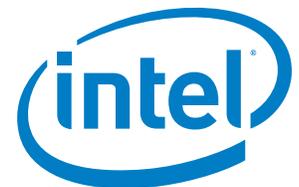# Mobilizing the Millennials

Ubiquitous Computing Enables Anytime, Anywhere, Any Way Learning

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One-to-One: Putting the Personal Back Into Personal Computing

Educators have long strived to provide a learning experience that not only reflects but is tailored to the needs and learning styles of individual students. The goal has been to reduce the distance between the student and knowledge, content and learning, experience and education. To that end, educational technology has been instrumental in making information available to students just in time, just in the right quantity and in just the right way.

During a blush of millennium-related predictions, libertarian futurist Lewis Perelman predicted that schools as we know them would be irrelevant by now as students interacted with teachers, colleagues and content from any location with their own computer. Perelman's vision can be seen today in the virtual schools movement — where ubiquitous networked computing is transforming the institutional brick-and-mortar schools he once decried. Indeed, over the last decade, most schools have made a conservative effort to get wired, connect classrooms, improve student-to-computer ratios, train teachers and students and collect valuable student data, making it possible to have individualized instruction. But what if, as Perelman predicted, those classroom walls simply stopped mattering? Are we at a point in our evolution when it is time to move to one-to-one computing and fully extend our teaching and learning environments well beyond the walls of the school?

One-to-one computing — originally defined as each teacher and student having 24/7 access to a computer and software — has emerged as a personalized platform for teaching and learning with wireless connectivity that greatly improves Internet accessibility. One-to-one computing now provides anytime, anywhere and any way access.

One-to-one initiatives take various forms. Many schools start out by providing a Web-based infrastructure to unify data stored in disparate systems and collect crucial data that assists administrators with district-wide data analysis and reporting, cohort and longitudinal analysis and identification of systemic trends, ultimately helping all teachers make informed instructional decisions that help improve student achievement. Equipping classrooms with sufficient workstations or laptop carts is essential to ensure that each student has access to a networked computer in each classroom and essential student data can be collected, allowing teachers to make data-driven decisions to individualize teaching and learning.

One-to-one programs range in size from small pilot programs to system-wide implementations such as the state of Maine's deployment of 34,000 computers.

Whether the program is big or small, the goal of one-to-one computing is to provide teachers and students access to all the benefits of using technology, which include:

Administrators can more efficiently:
- Identify systemic trends
- Gauge progress toward meeting AYP mandates
- Perform cohort and longitudinal analysis
- Provide teachers immediate access to student information, including historical performance, discipline, attendance and information from a central student profile
- Succession planning for staff

Teachers can more efficiently:
- Differentiate instruction based on student performance
- Plan, schedule and track standards-aligned instruction with ease
- Provide access to exemplary lessons and instructional resources
- Analyze student progress and mastery of standards with item analysis and trend reports

Students can more effectively:
- Increase use of technology as a tool to improve and accelerate learning
- Engage in improved student-teacher interaction
- Access "smart" interactive, multimedia content
- Prepare for higher education or a career

(Bebell, 2005; Rockman, 2003; Pascack High School District, 2004; Center for Digital Education, 2005).

> Moving to one-to-one fully extends our learning environments well beyond the walls of the school.

This paper has been prepared to assist in the consideration of whether and how to achieve a collaborative and well-designed one-to-one initiative. It presents information to help education leaders understand the vital elements and key considerations of one-to-one computing initiatives. It highlights the value of one-to-one computing to the district, schools, teachers, and ultimately, the students, parents and the community. This paper also introduces a blueprint for action that features six elements to consider when embarking on a one-to-one computing effort. These elements include leadership, funding, infrastructure/architecture, curriculum solutions, professional development, resources and results (See page 6). But before addressing the components necessary for achieving one-to-one ubiquitous computing, it is useful to think about the propositions for moving in this direction — the what and the why of one-to-one computing.

Moving to one-to-one fully extends our learning environments well beyond the walls of the school. One-to-one computing provides 24/7 anytime access from any location, not just within the classroom. With assistive technologies, it is also available in any way necessary to accommodate different learning styles.

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PROPOSITION 1:

Lifelong Learning and the Digital Majority

As the world continues to shift from an industrial-based to a knowledge-based economy, students must be prepared to successfully meet the challenges they will face as they enter higher education or a career. Districts and schools have the responsibility to teach students how to use prevalent technological tools to analyze, interpret and communicate information, thus enhancing the probability of each student succeeding. And it is not just individual student success that is at stake; the future of our communities, the economy and even national sovereignty is riding on getting education right.

The world increasingly continues to connect and communicate — so much so that those accessing the Internet have become the "digital majority." Approximately three-quarters of American households have Internet access, more than half of which is broadband (Pew, 2005). According to a recent study of Internet access in schools, the Pew Internet and American Life Project found that fewer than 15 percent of students report not having Internet access from school, home or both. The number of individuals in the "digital majority" expands each year, extending to demographic cohorts (by ethnicity and age). No matter what age a person may be, they want to be connected. The ability to stay in close communications via e-mail, share documents and information, research information with ease, access personal banking 24-hours a day, download music or compare products and prices has made connectivity indispensable.

Whether for informal or formal learning, more Americans are using the Internet for education and training purposes. In the last few years, universities have begun to understand the power of the online medium in reaching traditional and nontraditional educators and students. Some 90 percent of four-year public institutions and more than half of four-year private institutions offer some form of online education (U.S. Department of Education, 2004). Access to various courses no longer depends on where a student lives, but rather on access to the school connectivity, making home-to-school online connectivity critical to successful educational outreach.

Although schools have connected, many students still face what researchers have called the "digital divide." When students leave the school environment, their access to digital learning tools becomes limited, leaving them without the means necessary to compete, creating a chasm between themselves and their classmates. This divide has been one of the major factors in states and districts organizing one-to-one initiatives (Center for Digital Education, 2005). Another more subtle divide exists between those who have dial-up Internet access as opposed to broadband (Pew, 2005).

More schools have come to realize the importance of a one-to-one ratio as the need for technology-savvy individuals has intensified around the globe. Providing a personal computer to each educator and student

helps teachers individualize instruction and motivates students to improve the quality and quantity of their work (Swan, Hooft, Kartcoski & Unger, 2005). It allows each student to master 21st century skills. But it is not the numbers of computers alone that drive change in schools. Instead, lowering teacher/student-to-computer ratios allows other activities to occur that create a real environment of change and improvement. The value of such activities, such as professional development, increases as students and faculty gain better access. With more access, professional development can become more meaningful, teaching can become more targeted, learning can become more individualized through data-driven decision-making, dynamic curricular solutions become more frequently available and leaders are able to take more effective steps to raise student achievement.

Around-the-clock availability of personal computers with online access serve as necessary tools in business, providing workers a private workplace to collaborate as needed, when and where they want. Likewise, through data collection, analysis, tracking and reporting, students now have access to targeted, differentiated learning, assignments and resources anytime, anywhere. Just as business has shifted from an industrial to a knowledge-based model, educational institutions must shift from the linear, synchronous, assembly line-style of teaching and learning to student-centered differentiated learning for better prepared, competitive and successful world citizens.

Learning Anywhere — in Real Time
Learning What's Possible

Classrooms are a learning environment, not *the* learning environment. Learning can take place anywhere; the determining factor being the ability to access learning resources.

As Perelman said, the *place* of learning would become less important. One-to-one computing extends contemporary learning tools to wherever the action might be.

As computing power increases and technology advances are made, the ability of software solutions to access disparate student data that enables teachers to make data-driven decisions and personalizes the student learning experience is crucial. Amplified computing power also creates a more realistic multimedia experience that engages students and motivates them to learn.

One example of where place is becoming less important is virtual schools. A virtual school is the repository of online curriculum and assignments that students can access anytime. Over the past five years, virtual schools have been created in at least 15 states. Twenty-five percent of public schools have some form of virtual school or online curriculum. Virtual schools offer flexibility to students and provide teachers the opportunity to create a more adaptive instructional environment (National Tech Plan). The flagship of K-12 virtual schooling is the Florida Virtual School. During the 2003-04 school year, more than 13,000 students enrolled in at least one or two courses. Today enrollment exceeds 33,000.

One-to-one computing requires curriculum in a content-neutral environment that engages, challenges and promotes learning. While it is challenging to keep pace with changing culture and advancing technology, curriculum development and digital content are an integral part of the solution for meeting students' new style of learning.

Moving Up the Technology Scale

To measure student access to technology, educators typically use a student-to-computer ratio. In the late 1980s, schools were considered fortunate to have even a 20-to-1 ratio, meaning 20 students to every one computer. During that time, each machine represented a relatively large financial commitment. In the early 1990s, schools set a 10-to-1 ratio goal. As computer prices fell and districts realized the benefit of these machines, 4-to-1 or 5-to-1 goals became more typical.

With each successive step to improve the student-to-computer ratio, the number of computers in schools increased. Typically, computer labs were established and students were rotated through these rooms. As the personal computer evolved, districts gave teachers computers, had older labs upgraded and installed mini-labs in the classroom setting. Today, districts and schools are progressing toward a one-to-one ratio, where the computer moves with the student instead of the student moving to the computer.

PROPOSITION 2:

Supporting Different Learning Styles

Each student responds uniquely to specific classroom environments and instructional practices based on what they already know and how they are wired to learn. Each student's cognitive approach is as individual as their physical makeup. Researchers have attempted to categorize the way students learn by using diverse learning theories such as "brain dominance," conceptual tempo, mind styles, modalities and multiple intelligences.

Students have different learning styles and abilities; some learn better visually, some aurally. Assistive technology is any technology that enables disabled individuals to more easily perform tasks. Examples include adaptive keyboards or telephones, screen magnification software and speech input software. Increasingly, assistive technology is seen as technology that helps anyone who needs it, and some school officials believe all students do.

Regardless of the choice of framework, educators have learned that it is vital to understand and use data to help target instruction so students have the opportunity to learn the best way they can. Video clips, online discussions, instant messaging, access to experts, multimedia, online professional journals, games, simulations and blogs all provide different avenues to learning. When teachers can provide data-driven instruction and students have 24/7 access to a laptop, they hold the keys to accelerated, individualized learning. No matter the topic or standard to be achieved, students who have expanded access to the Internet and technology tools have more opportunities to discover information presented in a way that reaches them. For example, one-to-one computing has shown the most impact for low-achieving and at-risk students (Mitchell Institute 2004).

MacArthur High School, in the suburbs of Dallas, has earned the state's highest academic ratings for the past four years. MacArthur's one-to-one computing initiative has enabled its diverse student body — with 40 percent of students below the federal poverty level and more than 17 percent non-native English speakers — to improve academic results and to provide all students with a chance for success.

If these students were not able to access the resources that are essential for learning 21st century skills, the school felt these students' futures were in jeopardy. Student Aida Jobe, now adept at technology, says she is "dreading not having a laptop when going to college and can't imagine living without it." The new classroom approach at MacArthur is student-directed and student-engaged, which means student-centered. Brandy Wall, an instructional technology specialist and history teacher, said that since the one-to-one implementation, suddenly even the most introverted kids are also contributing, participating and even sharing their valuable technology skills. According to Principal Tracie Fraley, "I'm seeing teachers change their instructional style. They are moving away from being the sage on the stage to facilitated learning. Students have ownership of their learning and their products, as opposed to just regurgitating what the teacher says. The level of understanding and higher-order thinking we're seeing our students produce is astounding."

Leveraging Existing Habits

Building on Existing Lifestyle
A disparity exists between the culture of schooling and actual technology use and work scenarios. If proficiency in technology is required to be competitive in the workforce, then why wouldn't technology in education be the mainstream tool for teaching and learning?

One-to-one computing programs take advantage of how students interact with the world around them and build on deeply imbedded habits. Today's students are accustomed to learning and communicating using technology. They get online whenever and wherever they can. In 2005, more than half of teens reported going online daily with 24 percent announcing that they go online several times a day. These teens access the Internet from home (87 percent), school (78 percent), a friend or relative's house (74 percent), the library (51 percent) or other community settings (9 percent). They get online to communicate, work and play games; 83 percent report that most of the people they know are also online; and 86 percent of all teens believe the Internet helps them do better in school (Pew, 2005). To them the physical and electronic worlds are one.

In their school life, teens find creative ways to harness the power of technology to be more successful students. Students describe using technology in school as a virtual textbook, reference library, virtual tutor and study shortcut, virtual study group, virtual guidance counselor and as a virtual data storage area (like a locker, backpack, and/or notebook) (Pew 2002). Giving students access to computers and connectivity inside and outside of the school day is vital and allows students to perform these functions anytime or anywhere.

New Expectations — the Millennial Perspective
Marc Prensky, author of *Digital Game-Based Learning* (2001), describes today's students as "digital natives" who move at "twitch speed," prefer graphics before text, can parallel process and multitask and who function best when networked. Instant gratification and frequent rewards motivate them. They prefer interactive, graphical, non-linear experiences over didactic, text-based linear interactions. These preferences suggest that high-quality electronic content might be more successful in engaging our students than older, print-based materials (2001).

Based on the work of Neil Howe and William Strauss (2000), the U.S. Department of Education in its National Technology Plan (2004) refers to these same students as the "Millennials." Millennials value doing well in school, plan on receiving a higher education, use computers frequently, spend more time online than watching television, create personal Web pages and are "ultra communicators." They use various electronic modes and methods to share, coordinate and complete tasks. Whatever the label — digital natives, Millennials, or Gen Y — students are ready to learn, expand and grow using technology. Now the challenge is to provide students with the tools that allow them to maximize their learning. And meeting this challenge requires leadership with vision that champions a one-to-one program

**Always-On Schools,
Homes and Communities**

As wireless network technologies advance, cities and other government entities have begun to understand that providing Internet access to their citizens, on a limited or no-fee basis, can revitalize and enhance the economy and living experience in their communities. School districts are capitalizing on these efforts to form partnerships.

The Fullerton School District in California, for example, began a one-to-one laptop program when the city installed a wireless network in the downtown area that encompassed the main city library. By provisioning wireless access throughout this space and providing laptops to students, the city and the school district helped students to extend their learning beyond the school day. Since many students who regularly visited the library did not have Internet access at home, this insightful wireless initiative allowed these students to have the same advantages as their peers. The Fullerton laptop program was so successful with middle school students that the district expanded the initiative into certain elementary school classrooms the following year.

As new wireless technologies light up campuses, such as the IEEE 802.16 standard that specializes in point-to-multipoint wireless access — broadband access will become as ubiquitous as cell phone coverage. With greater available connectivity, more districts and parents will see the necessity to help their students connect and learn.

Ubiquitous access to the Internet allows for "always available" interactive content, in other words, a learning environment where students can research, study, interact and successfully learn anytime and anywhere. Smart programs provide instant individually directed feedback, which gives students a real-time opportunity to discover what they do not know and what they need to do to learn it.

Implementing One-to-One

Seven Key Components

Seven key elements are the foundation of a blueprint for action to move toward one-to-one computing:

- **Leadership:** Implementing a one-to-one initiative requires extensive planning, goal setting and systemic change. Building a school system based on School Performance Management Systems that use data to increase academic achievement requires policy development, ongoing communication and especially a visionary leader to champion the cause. A structured change management approach toward ubiquitous computing enables systemic change — changing entire school systems, not just school districts.

- **Funding:** Funding methods for a one-to-one program can be challenging; therefore, seek creative approaches to traditional and outside sources. Add a budget for long-term sustainability and scale.

- **Infrastructure and Architecture:** From hardware and software to connectivity, this component includes such factors as policy (use, refresh rates, equipment replacement and so on), security and technical support.

- **Curriculum:** From textbooks to Internet and courseware options, developing content-neutral management systems must meet the needs of 21st century learning. Courseware options should draw heavily upon rich digital content.

- **Professional Development:** PD management and implementation based on individual assessments must begin early in the process and be ongoing for teachers, administrators and staff.

- **Resources and Results:** Progressing toward learning objectives requires data collection, data coaching and modeling based on other successful programs and ultimately developing methodology for measuring results from your one-to-one initiative, be it student, class, teacher, administrators or the entire school district.

- **Policy:** Policy is the base of all successful one-to-one computing models and accelerates 21st century learning. One-to-one implementations will struggle without policy to provide a framework and support. An example of strong leadership and policy can be seen in the Maine Learning Technology Initiative. The initiative came about as a result of then-Gov.

King's proposition to use a $50 million budget surplus to buy laptops for middle school students and teachers. A task force of the Maine Legislature agreed, designing a proposal that received bipartisan support and launched the state into the first statewide learning with laptop initiative. A vendor was selected after a rigorous RFP process, and the Maine Learning Technology Initiative (MLTI) launched in the winter of 2002. One trial site in each of Maine's nine Superintendent Regions was identified to pilot the project. Buildings were wired for wireless, teachers received training and laptops arrived at the schools. These pilot sites tested the network and laptop solution and gave other educators a place to visit to see what to expect. Maine recognized that initiatives that stay focused on teaching and learning have more impact on student achievement than those that focus on the technology. Maine accomplished

> Strong leadership is essential for one-to-one initiatives. Leaders need to establish a vision for teaching and learning and appropriate policies need to be created. Initiatives should include an "Acceptable Use Policy" that describes what everyone in the school or district can and cannot do with regard to the computers and technology.

Leadership began with a collection of classroom teachers, administrators, state Department of Education personnel, higher education faculty and educational consultants charged with setting the direction of the project. Their first charge was to build a network of teachers in each building to act as points of contact for two-way communication between the state and each school. These teacher-leaders from across each region met by region, together with their principals and technology coordinators, twice per year. Leadership development opportunities were made available and school leaders were given strategies for building a vision working with their staff.

Strong leadership is essential for one-to-one initiatives. Leaders need to establish a vision for teaching and learning and appropriate policies need to be created. Initiatives should include an "Acceptable Use Policy" that describes what everyone in the school or district can and cannot do with regard to the computers and technology. This policy should include:

- Appropriate or acceptable educational uses of the resources
- Examples of inappropriate or unacceptable use and consequences of such misuse (Maine disconnected the network on the laptop of any student who had an Internet "violation")
- Duration of the loan period
- Liability
- Web and e-mail access guidelines and regulations
- Care instructions
- Security instructions
- Computer and Internet instructions for home use (Maine had a policy not to allow laptops home without a parent's signature)

The following table shows at a glance the key functional areas to address when moving toward a one-to-one initiative. For details on the components and tips on progressing from one stage to the next, see the publication *Blueprint Solutions for K-12 One-to-One Computing Initiatives* (Intel Corporation, 2005).

BLUEPRINT COMPONENTS:

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

CONCLUSION

Technology is now able to deliver on the promise of enriched educational environments, high-quality content is available and students have embraced the Internet and they are ready to learn. Today, because teachers can help individualize learning through data-driven decision-making solutions that can transform data into a powerful tool to help individualize learning and one-to-one computing, students can learn in their way, anytime or anywhere, getting just-in-time solutions, just the right way.

We are quickly coming to the point at which one-to-one computing will be a non-negotiable part of giving students the ability to be successful. To provide educational technology — in the way that truly reaches all students — requires strong state, district and school leadership to champion one-to-one computing initiatives.

Managing a one-to-one initiative is a comprehensive undertaking. The seven blueprint elements mentioned here provide a framework to help shape the conversation as you involve all stakeholders in making one-to-one computing a reality in your community.

For more details, see Blueprint Solutions for *K-12 One-to-One Computing Initiatives* and visit <www.k12blueprint.com>. It is a changing world, a world that students are going to help create because they have access to these tools. As business and management expert Peter Drucker claimed, "The best way to predict the future is to create it." This change can be a reality once learning is individualized and contemporary tools are put in educators' and students' hands.

As education evolves and revolves around information access, the question becomes not *if* but instead, *how quickly* we will give our students the best access to technology to accelerate their success.

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