



IBM White Paper

1-1 Computing in K-12 Education

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Executive Summary

1:1 computing is a fast-growing option for K-12 schools.

School districts across the U.S. have embarked on large-scale 1:1 initiatives to equip each student with a mobile computing device. In fact, 1:1 computing has become an educational best practice that—along with professional development for teachers, project-based learning methods, and student-centered learning—can improve the effectiveness of education on all levels: students, teachers, and administrators. Key goals of 1:1 computing programs include: raising student performance, enriching the learning environment, increasing teachers' efficiency in the classroom, extending the learning environment beyond a school's walls, better connecting schools to families and communities, and providing students with the necessary skills to succeed in the 21st century workplace.

1:1 computing has moved beyond pure technology when it is focused on transforming teaching and learning processes.

At its inception, 1:1 computing meant providing laptops to students and teachers for anytime, anywhere learning. Although 1:1 computing is one of the fastest growing initiatives among K–12 school districts, the results of many of these efforts show that providing each student with a laptop is not sufficient to fully harness the power of today's technologies, to best engage students, to improve achievement, and to provide students with the skills they need to live and work in today's technology-reliant society.

Successful 1:1 includes a cycle of services that involves a cradle-to-grave implementation process.

Educators now realize that instructional content and technology integration strategies are essential to transforming the educational process. So too are professional development, a solid network infrastructure and maintenance program, concrete goals, and a benchmark by which to measure those goals. IBM is helping district officials meet the demands of 1:1 computing and achieve designated benchmarks by looking at core elements that, when combined, enable school districts to more effectively change their teaching and learning paradigm and capitalize on the power 1:1 computing brings to education. The core elements of IBM's approach to 1:1 computing include:

- Providing access to **multiple devices** (e.g. hand helds, laptops, thin clients) and to a system that provides flexibility to work with various devices as well as operating systems (e.g. Linux) for more affordable 1:1 computing opportunities.
- Implementing **life cycle services** that include infrastructure planning, academic and business goals, procurement, system integration, implementing digital content, professional development, help desk support and maintenance.
- Integrating appropriate **application solutions**—human resources, payroll, test scores and other digital content—to meet the needs of students, teachers, and administrators.
- Operating an **education portal back-end** to store all of the applications and work in which a district's stakeholders are engaged.

IBM is expanding the concept of 1:1 computing beyond the technology.

IBM's comprehensive 1:1 computing capabilities are based on 80 years of experience helping K-12 schools improve student achievement and aiding administrators in relieving system maintenance burdens and remaining focused on their educational missions. Steeped in that background and technology, IBM enables school districts to adapt the learning environment for the future.

The Changing Face of 1:1 Computing

With the growth of technology in K–12 schools, educators and education-technology leaders have grappled with finding the proper computer-to-student ratio. They determined that the ideal is 1:1 computing, in which each student is able to use a computing device in order to learn anytime and anywhere.

1:1 learning has evolved beyond laptops and the simple focus of technology.

When 1:1 initiatives debuted about a decade ago they involved providing students with a laptop computer. One-to-one computing and learning has since evolved beyond that simplistic approach. It now involves multiple computing devices—laptops, Tablet PCs, handheld PDAs, portable keyboards, etc.—in an effort to revolutionize how instruction is delivered, to better engage students, and to encourage them to play a greater role in their learning. Today, 1:1 initiatives begin, not with the equipment, but with a planning process that first assesses the district leader’s goals, and then considers, among other factors, the finances to put those goals in place, the district’s capacity to handle technology upgrades, staff training, and technical support for the new and existing hardware and software.

Research shows that investing in 1:1 computing has helped improved student achievement among other academic successes.

Academic Improvements from 1:1 Computing

Most research has found that investing in 1:1 computing has paid off for school districts, helping to improve students’ academic achievement, communication, and teacher performance. According to a 2005 report by the *Journal for Technology, Learning, and Assessment (JTLA)* students in 1:1 programs:

- Score higher in writing assessments.
- Have better analytical skills.
- Engage more in problem solving.
- Have higher student achievement.

A *JTLA* analysis of a 1:1 initiative implemented in 2001 by the Harvest Middle School, in Pleasanton, California, showed that sixth- and seventh-grade students who participated in the program posted a 10% increase in their grade-point averages

during the 2003-04 school year compared to non-program participants. There was also significant improvement in language arts and math among program participants. In West Virginia, a 1999 study of that state's Basic Skills/Computer Education initiative found that the more students participated in the state's computer program, the more their test scores rose on the Stanford 9 achievement test.

A report by the independent research firm, Rockman et al (1997, 1998, 2000), which evaluated Microsoft Corporation's *Anytime, Anywhere Learning Project*, found that students involved in 1:1 computing programs:

- demonstrated increased critical and creative thinking
- spent more time engaged in collaborative work
- wrote more and produced a higher-quality of writing
- had better access to research and information
- were more motivated and interested in core academic subjects and
- spent more time on homework when done on the computer

The report, "Powerful Tools for Schooling", noted that 1:1 initiatives—in this case laptop programs—help improve the way students learn and teachers teach and develop critical skills that will serve students in tomorrow's workplace.

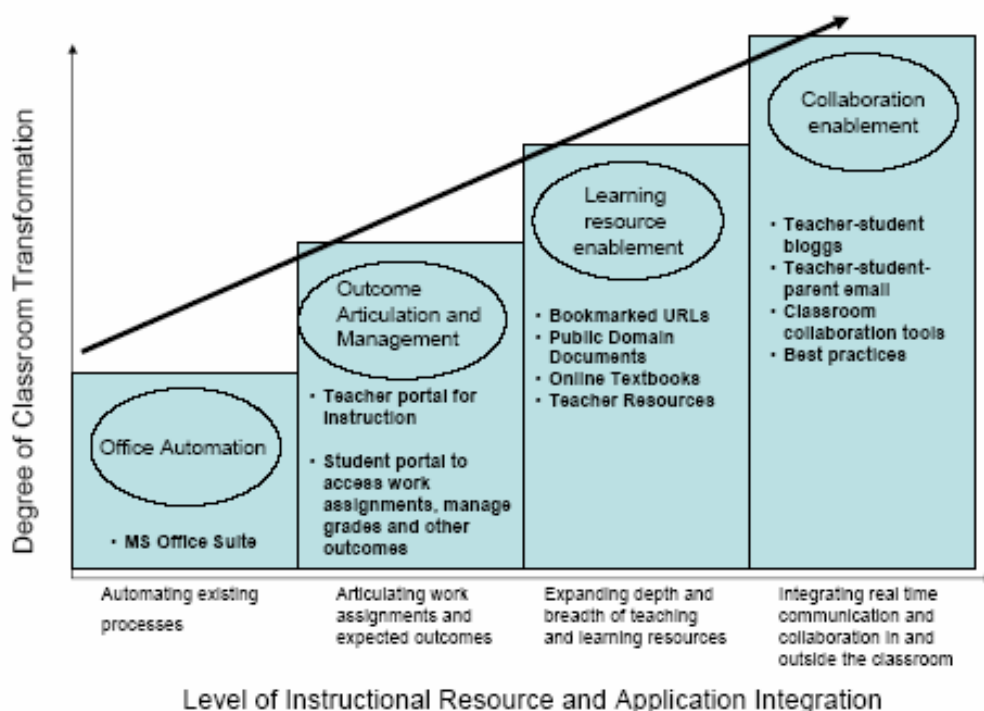
Although technology continues to change and evolve, the research is clear on one point: Routine access to technology will increase learning in environments where educational expectations have been clearly articulated. To date, more than 10 states are following the lead of the first-generation of 1:1 computing users, such as Maine and Michigan, and considering 1:1 computing initiatives. In 2003, 8% of public schools had laptop-loaner programs for students, according to the U.S. Department of Education. The educational research firm, Market Data Retrieval, notes that laptop integration and use in districts rose to 17% in 2004 from 13% the previous year.

More than 10 states are following Maine and Michigan—the first generation of 1:1 initiatives—and considering 1:1 initiatives themselves.

Key Components of Successful 1:1 Computing

Central to a viable 1:1 computing initiative is articulating a clear vision, goal and degree to which teaching and learning in a district should be transformed.

Core to a 1:1 computing program is establishing and articulating a vision for the program (i.e.—the desired end result of teaching accomplished through a 1:1 program) and then doing the same for the initiative's goals. The goals can be measured by students' standardized test scores, attendance rates, or dropout rates. The goals can also be defined to measure the degree to which educational processes have changed (e.g.—the number of days it takes to teach a particular curriculum area, the number of late or missing homework assignments, etc.). To make this work, it is important to align the 1:1 program to the vision and goals as illustrated in the following diagram.



The above diagram shows the possible strategies and the types of goals a district can seek to achieve (along the X axis), and the degree to which the achievement among students and teachers in the classroom can be transformed depending on the type of strategy that's implemented (along the Y axis). It is important for school district officials to determine how far they want to transform teaching and learning before implementing a certain technology strategy.

Once a district has identified its vision, goals, and instruction technology strategy, the next step involves implementing four core elements to help solidify and strengthen the 1:1 computing initiative:

- Identify the type of devices to be used (e.g.—handhelds, Tablet PCs.)
- Establish a life cycle of services to assess a district’s needs and capacity— planning, procurement, integration, training, support, and maintenance.
- Select the appropriate application solutions to meet the needs of students, teachers, and administrators.
- Integrate a portal back-end solution to store all of the applications and work of the district’s stakeholders.

1:1 initiatives help improve the way students learn and the way teachers teach.

Successfully implemented 1:1 initiatives have helped improve productivity among teachers, students, and school and district administrators. There are also numerous schools with a plan to create learning processes that truly integrate technology in the best ways to improve teaching and learning and transform them to comply with 21st century skills. One such school is McKinley Technology High School in Washington, D.C.

McKinley High—The New 1:1 Generation

McKinley Technology High School, located in the heart of Washington, D.C., has a strong focus on technology to provide students with the skills to take them well into the future. With a curriculum based on three technology tracks—biotechnology, information technology, and communication technology—McKinley’s principal told the Washington Post that his vision for the school is to provide “a traditional liberal-arts education enhanced through the use of 21st century technology.” The school is the most technologically sophisticated public school in the city, equipped with wireless Internet access and Ethernet connections linking classroom computers to a high-speed network. The school, which opened in 2004 after years of renovation, has also been designed to support a 1:1 program and will integrate such an initiative based on a technology-integration process that allows teachers and students to instruct and learn collaboratively and at a higher academic level. McKinley officials are currently designing a program to “reengineer” a teaching and learning process to move teachers and students from the simplistic forms of

technology use (e.g., producing essays in Word, creating a presentation with PowerPoint) and toward a process that includes the following:

- A “self-service” environment where students and their parents can better understand teachers’ expectations and manage their own learning outcomes.
- An expanded use of teaching and learning materials that extends beyond the classroom.
- More real-time collaboration between teachers and students throughout the learning process.

It is through this type of learning platform—supported by the right professional development—that McKinley Technology High School administrators seek to drive academic achievement and technology use in the classroom.

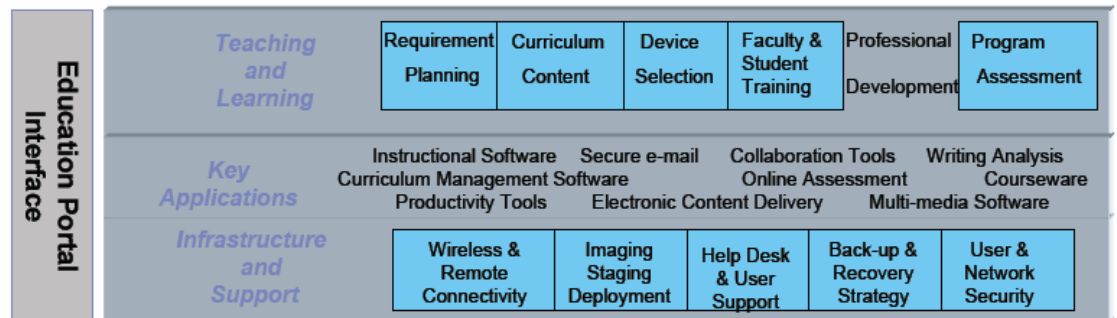
Developing a 21st-Century Workforce

While the case can be made that well structured 1:1 programs can make an academic difference, there is also the question of whether 1:1 initiatives provide the general skill set needed to prepare a high-school student for higher education and ultimately the workforce. Students will be more successful when they can take advantage of the information resources available through a 1:1 program and turn that into knowledge that can be leveraged in today’s evolving economy. Indeed, many school district officials view 1:1 computing as a way to restore and maintain their region’s economic vitality by building a cadre of graduates with 21st-century workplace skills. The nonprofit organization Partnership for 21st Century Skills lists a necessary skill set for students—media literacy skills, critical thinking and problem solving, self-direction and collaboration, etc.—that mirror the knowledge that students of 1:1 programs acquire. Saul Rockman, an education-technology expert and head of Rockman et al, has said “the effects of laptop programs appear to be the greatest on those 21st century skills that make a difference over time and are the necessary preparation for productive work in school and beyond.”

1:1 initiatives must be implemented systematically and fully to be effective.

IBM's Cycle of Services Leads to Successful 1:1 Initiatives

IBM believes one-to-one initiatives must be implemented systematically and completely. That means a program does not begin and end with the purchase and installation of hardware and software. Instead, school district administrators must look at the entire picture and that includes an extensive review with a district's goal and vision for 1:1 computing as its central mission. IBM has developed a planning and integration system that takes administrators from the beginning of a technology-implementation process to the hardware installation, training, education portal, and follow-up maintenance and support. As the diagram below shows, the process considers two main components: teaching and learning and infrastructure and support, the key areas connected to the main components and the key applications linked to both.

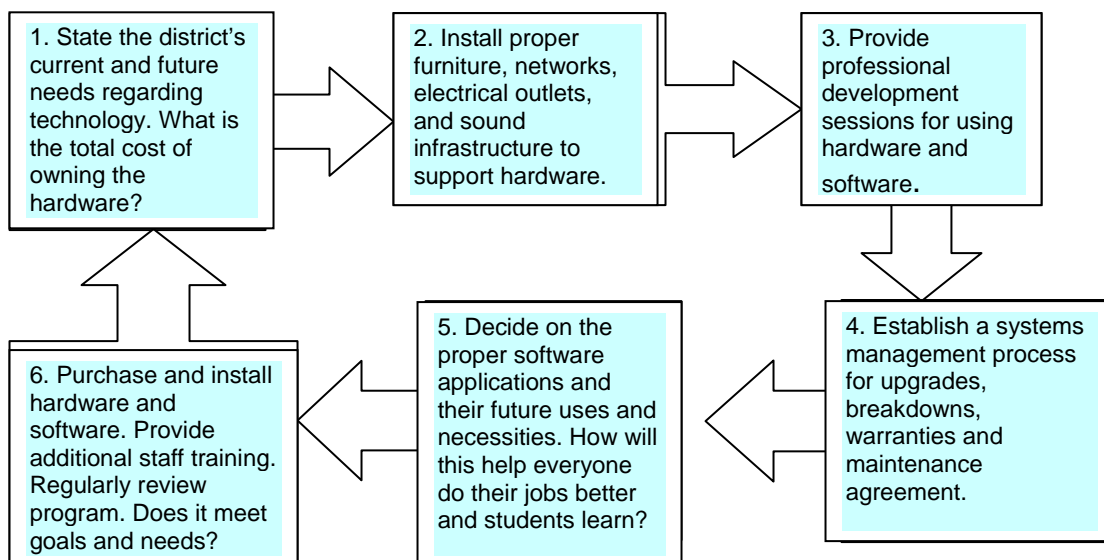


Examples of IBM's 1:1 Program Services Approach

Memphis (TN) City Schools employed IBM's lifecycle of services approach to plan, implement and maintain the 1:1 initiative that the district began with IBM's help. IBM helped the school district in managing the entire technology integration, creating a lifecycle that was similar to the following:

IBM's life cycle solution includes training, infrastructure planning, service and much more.

IBM's lifecycle of services helps districts develop comprehensive implementation plans



IBM's success in managing and supporting technology integration efforts in schools has been longstanding and is evident in districts such as Clovis Unified, in Fresno County, California:

Helping Clovis Schools See the Future

In the seven years that IBM has worked with Clovis Unified, the company has provided access to high-quality tools, brought in new and innovative ideas for better communication within the district, with Learning Village, and helped update the communication system over time by introducing ClickPlace, a web-based collaborative tool. IBM also helped Clovis Unified officials set up, expand, and later update the district's 200 servers. And it guided district officials on how best to scale up their 1:1 computing program from students-only system to a district-wide program with teachers and administrators using laptops or other portable devices. The relationship between the district and IBM continues today with an annual two-day conference at Clovis Unified where IBM brings in ed-tech experts to discuss specific needs with district staff. In past years, the conference has helped the district ramp up its digital warehousing project. "We've had a terrific partnership with IBM," says Chuck Phillips, Clovis Unified administrator for technology services. "They've provided us with a wealth of expertise and insight to look to the future, they made us think about options we hadn't considered before, and they have an excellent quality of service."

IBM's relationships with schools and districts also provides administrators access to a network of expert IBM staff and to a pool of educators with first-hand experience with 1:1 computing programs. Such connections proved invaluable for Whitfield School, a private middle and high school in St. Louis, Missouri.

Connecting to a Network of Experts

IBM began working with Whitfield School in 2003. For an entire school year, IBM officials worked with Whitfield School administrators to develop a strategic three- to five-year implementation plan on out how best to integrate laptops into the learning and teaching environment. IBM also helped the school integrate an open source model for easier computing and lower software costs and hardware maintenance costs. To find the best open source tool for the school, IBM connected school officials with three IBM experts who had tested numerous open source operating systems and who provided a list of the pros and cons of how each operating system might work for the school. The company also connected school leaders to an extensive network of educators around the U.S. with first-hand experience with 1:1 initiatives.

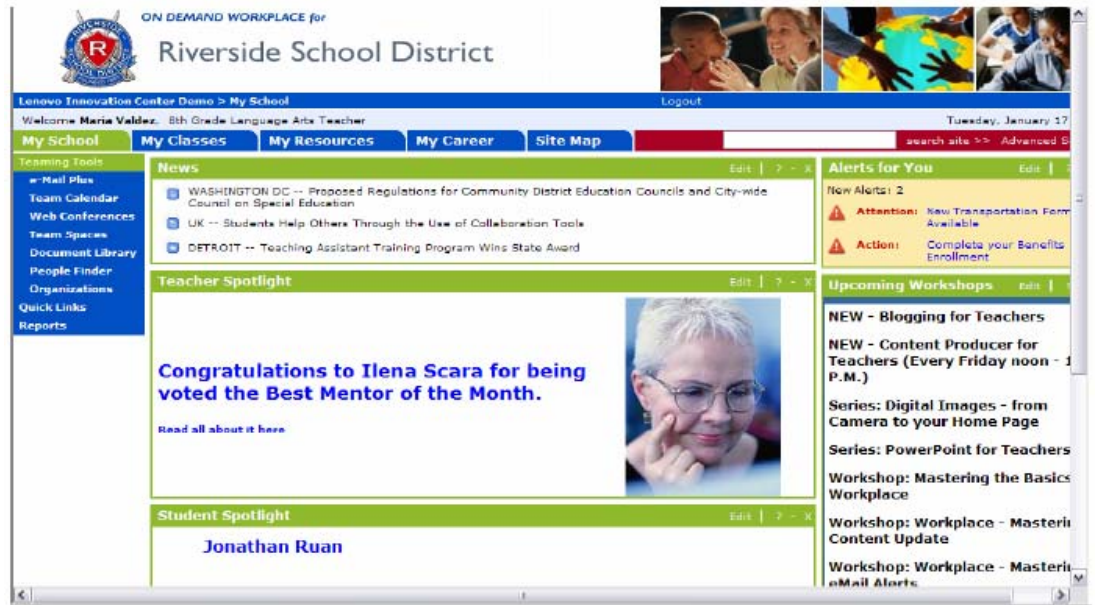
An education portal can help streamline communication and district information.

A Portal to Better Communication

IBM also understands that while a successful 1:1 initiative is important for a school district's success on many levels, a solid system to help streamline administrative tasks, critical information and productivity, and which will help improve communication is vital. This can be solved through a role-based education portal set up on the district's server. While a portal uses web technology to deliver information to a browser, it is not the same as a school's web page. With a portal, the information displayed by the browser is specific to that user; a parent's site will appear different than a student's site, which will be different than the teacher's or the administrator's view on the portal.

An educational portal can remove many obstacles that hamper a district's successful delivery of instruction. It can house applications that handle human resources and payroll information, students' test scores and attendance records, teachers' homework assignments, data warehouse information, and much more. Administrators are able to see records for their entire district, school, or for each classroom. Teachers can view their lesson plans, students' progress, and post information for students and/or parents. Students can see and post assignments, and parents can view their child's academic progress, homework updates, and notices from teachers. By providing access to select information, depending on a person's role in the district, an education portal can help improve communication and collaboration among

teachers, administrators, students, and parents. The diagram below shows a typical education portal—showing a teacher’s page—that IBM helps districts construct as part of IBM’s technology implementation efforts.



IBM Vision Aligns with K–12 Schools

IBM gets it! K–12 school districts need technology solutions that are readily accessible and support teaching and learning, but which also will be functional and applicable years into the future. IBM is crafting a new framework, approach, and definition of how 1:1 computing initiatives ought to be done. IBM’s holistic approach of incorporating its life cycle of services for technology implementation, its flexibility to work with multiple devices, its specialized education portal, and its extensive network of experts makes the company a standout in its approach to 1:1 computing. IBM has the flexibility to meet a district’s needs in terms of a device, curriculum content, open-source models, and more. It has a competitive help desk support structure. And its 1:1 portal interface is transforming communication and productivity in districts. Plus, IBM brings decades of education-focused research and technology—unlike any other technology company—to help school districts begin, manage, and sustain successful 1:1 computing programs.

IBM is connected to an extensive network of ed-tech experts.