



Expanding the Power of Education Through Personalized Learning

Advances in enterprise and consumer technology have enormous potential to improve how students learn, how teachers inspire and guide that learning, and ultimately how institutions organize themselves for the one metric that matters most: student success.

Improved access to digital content, educational performance data and popular consumer communications and collaboration technologies is ushering in a new era of data-driven education in which we can shift our institutional focus from what is being taught to what is being learned. In this emerging world of personalized learning, the student becomes the center of our collective attention through the use of either common or customized curricula that are informed by regular assessment data and tailored to the learning needs of the individual. Technology can enable learners of all ages to become more active and invested in their education, whether they are guided by a teacher or learning in a more self-service manner.

In many respects, most of today's classrooms aren't much different than they were after the Industrial Revolution: students sitting at rows of desks, taking notes on paper as the teacher lectures from the front of the room—the emphasis being less on learning than on teaching. Insights derived from cognitive and behavioral science have advanced our understanding of how individuals learn, and this has led a growing number of institutions in both the developed and developing world to marry more data-driven instructional approaches with technology to deepen the connection and collaboration between teachers and students.

Policy Briefs from Microsoft

A convergence of innovative software and intelligent devices, complemented by cloud-based services, will stimulate economic growth, make government more effective and benefit citizens in areas ranging from education to health-care to the environment. This policy brief is one in a series from Microsoft about next-generation computing.



Using Data to Drive Innovation and Outstanding Results



At the [Denver School of Science and Technology](#) (DSST), advances in brain research and communication practices from the fields of advertising and entertainment are combined with data on student performance to continuously improve teaching practices and personalize each student's learning experience. Teachers collaborate before class each morning to analyze student data and identify

areas for instructional improvement on behalf of individual students or groups who share a similar learning profile. Portions of this data are simultaneously made available to students as a digital record of their progress toward mastery of that semester's goals. At the end of each school year, the past year's performance data is synthesized by staff over the summer to inform the next year's lesson planning and course design.

In such an environment, teachers are expected to act as designers of learning. Using innovative instructional methods featuring "hooks and connections" to engage and retain attention, repetition to build fluency in core concepts, and "spiraling" to reinforce critical knowledge, teachers are expected to design learning experiences that can be replicated and built upon by their colleagues. Common lesson plans are used to ensure consistency of instruction, and all educational materials—including assessments, simulations, teacher videos, interactive exercises and homework assignments—are stored in a central repository that is accessible to all faculty.

Now in its fifth year, DSST is the only high school in Denver to receive a "Distinguished" rating from local authorities. With six times more low-income students of any top-10 school in the city, DSST has seen 100% of its graduates accepted into four-year colleges in the past two years.

At institutions as diverse as the Denver School of Science and Technology, the Lumiar Institute in São Paulo, Brazil, and the Open University in the United Kingdom, we can see glimpses of an exciting future for education in which students are encouraged to take greater responsibility for their learning and use technology to acquire new skills, explore ideas and collaborate with teachers, peers and others to analyze and solve real-world problems.

With determined leadership and education policies that encourage the appropriate use of technology, reward proven practices and embrace a multi-stakeholder approach, governments can help realize the educational possibilities offered by next-generation information technology (IT).

At Microsoft, we believe that IT can help transform education in four critical ways:

- By ensuring that every student has access to a world of relevant and personalized learning
- By enhancing the capabilities of teachers through technology-driven insight, tools and teaching methods
- By empowering administrators with the software, services and data they need to build community and improve outcomes
- By strengthening learning in the STEM subjects: science, technology, engineering and math





In Singapore, the [Crescent Girls' School](#) has integrated the Tablet PC into the process of learning using a project-based approach. Recognized by the Singapore government for its teaching and learning practices, the school mentors other schools in 12 countries under the Microsoft Innovative Schools Program.

Ensuring Student Access to Relevant, Personalized Learning

Given our increasingly digital lifestyle, the use of technology is essential to engaging with students. As Tony Wagner writes in *The Global Achievement Gap*, “boring classes and apathetic students are largely the result of this yawning gap between their everyday lives and the technology they use in it and what goes on in the classroom.”

By providing a familiar and engaging channel of expression, technology can be a powerful tool to draw students into learning and exhibiting the knowledge and skills they will need in the global marketplace. Students today respond to technology in a different way than did previous generations. For many, it is an essential way to connect to the world around them and is integral to how they master their environment and manage human relationships. The most innovative institutions are using this realization to their instructional advantage.

Schools as diverse as Shireland Collegiate Academy in the UK and the Crescent Girls' School in Singapore empower their students using connected devices and a range of digital content offered through personal portal pages. Students can personalize their pages to suit their learning needs using RSS feeds, teacher bulletins, assignments and instant message groups. Online activities can be completed on or off campus, as a team or individually. Embedded digital quizzes and tools inform students about how they are progressing, and self-paced learning modules can supplement teacher guidance.

Whether through inquiry-based expeditionary learning or rigorously structured, sequential programs with in-depth focus on essential concepts and skills, all students can benefit from more



dynamic, personalized learning. Technology allows them to learn in their own style and at their own pace, whether individually or collaboratively with peers who are nearby or on the other side of the world.

Enhancing the Capabilities of Teachers

Tracing an arc from Jean Piaget’s work on cognitive development to Howard Gardner’s theory of multiple intelligences to empirical education research at institutions such as Carnegie Mellon University, a growing body of evidence supports what teachers and education researchers have believed for some time: Each student is unique and learns in his or her own way, which makes personalized learning a priority for education. To quote American Nobel Laureate Herb Simon, “Learning results from what the student does and thinks and only from what the student does and thinks. The teacher can advance learning only by influencing what the student does to learn.”

Around the world, educators are seeking to develop more individualized approaches to teaching that take into account the learning goals of the lesson and that make learning more motivating, collaborative, and engaging for today’s students, who are used to multi-tasking, multi-media, and constant communication. Technology can also help improve how educators track each student’s progress, and tailor materials to match their learning style and needs.

Technology has the potential to help great teachers scale their impact, and facilitate the adoption of more effective teaching practices. This is particularly true as software and computer devices become more intuitive to use, provide access to more learning content, offer more real-time insight into group and individual performance, and provide greater interactivity and engagement for both teachers and students. Technology can also liberate teachers from administrative and compliance burdens by automating routine tasks. Attendance, assignments and submissions can be removed from the classroom equation so that 90 minutes of class time means 90 minutes of learning.

New education content search, authoring, and assembly tools and services will make it easier for teachers and students—as well as commercial publishers and government-sponsored programs—to digitize learning materials and turn great ideas into a common store of curricular content, reusable projects and simulations. At the same time, additional insight into student learning and visibility into colleagues’ practices will facilitate the creation of both formal and informal teacher mentoring networks, in the same way that interest groups have emerged and clustered on social media such as Facebook and Yelp. We see a wealth of opportunity for teachers to reach beyond their day-to-day environment and form bonds with a broader community of peers and experts in support of their students’ learning.

Empowering Administrators to Build Community and Improve Outcomes

It is often difficult for administrators to connect with parents, policymakers or peers to identify best practices in their own school or other education systems. This limits their ability to innovate and make improvements. To quote former New York District 2 superintendent Anthony Alvarado, “isolation is the enemy of instructional change.” Until we provide an infrastructure for education leaders to collaborate in real time and share their results, replicable evidence-based practices will be slow to spread.

Microsoft envisions an education system that empowers educators by facilitating connections and collaboration—a system that is more efficient and delivers data and insight on the learning taking place to teachers, students, parents, administrators and education policymakers. Within an individual classroom, or across an entire state education system, powerful analysis and business intelligence tools can provide support for enhanced learning environments and enable longitudinal data stores that give greater visibility into student progress, from kindergarten



to the workforce. Such information can form the basis for the community collaboration and insight that is essential to student persistence and success.

Technology can also help improve an institution's operations and free up time to focus on improving student performance. Many administrative tasks, such as alumni relations, facilities management and procurement, are being translated into automated software routines. Many governments are also liberating school leaders from technical support and data management tasks by using aggregated, hosted services that link client devices to Web-based services. This can allow school leaders to reallocate IT resources and staff to more of an instructional R&D function within the system. Indeed, early adopters of this approach, such as Queensland, Australia, and the London Grid for Learning, provide fascinating glimpses of what is possible when school systems adopt a utility-style infrastructure in which many clients share a common, secure community cloud instead of on-premises solutions.

Strengthening Learning in Science, Technology, Engineering and Math (STEM)



Microsoft, Per Scholas and the City of Miami are partnering to equip students with certified IT skills training. The program includes a free PC and help with finding a technology job in the regional economy.

Organizations such as the National Laboratories in the United States have argued that high-quality jobs drive a nation's prosperity, and that such jobs depend disproportionately on advances in science and engineering. Given the general health of STEM education around the world, the outlook for creating these jobs within many nations is concerning. It is not so much an issue of the number of graduates a nation generates in any one field as it is the preparedness of those graduates to effectively address their society's toughest issues. Advances in science and engineering also have a "bow-wave" effect on the broader economy as once-familiar routines become commoditized and new roles are introduced, requiring skills predicated on a greater facility with technology.

At Microsoft, we believe that IT can make a big difference in the training of our workforce in key skill areas and in how we engage and inspire students to learn science and engineering. As educators such as Carl Wieman at the University of British Columbia are demonstrating, digital curricula and learning resources can bring scientific concepts to life and ensure that students are developing domain expertise in a way that lectures and printed text alone cannot help them achieve. Virtual labs and simulation environments can provide affordable and interactive access for learners who might otherwise have none, while game-based approaches can be used to attract and engage them. Furthermore, emerging Web-based services such as the Open Education Resources depository and portals such as Academic Earth allow individual simulations or materials for entire courses by leading educators to be delivered directly to the classroom or the home.

In all of these examples, IT plays a pivotal role in raising the bar on STEM education and encouraging students to think and act scientifically to achieve mastery of critical concepts. With the advances being made in fields as diverse as biochemistry, nanotechnology and the new "hyphenated engineering" disciplines, we believe governments are at a critical juncture in reevaluating their approach to workforce readiness. The policies they adopt to encourage education that aligns with new industries will drive the next wave of global economic growth and the transformation of our existing industrial sectors.



Innovative Schools Stimulate Greater Learning

Lumiar Institute

Founded with the intent to serve public schools, the [Lumiar Institute](#) in Brazil is undertaking a learner-centric transformation in which the standardized curriculum is being replaced by a “mosaic” of competencies that are made available to each student and his or her “tutor.” A guidance counselor provides broader mentoring and support services to the child. The child’s parent or caregiver is also involved. All four people collaborate to develop a set of goals and pathways for the student, using a combination of project-based learning and business intelligence software for tracking the student’s progress.

Shireland Collegiate Academy

[Shireland Collegiate Academy](#) in Smethwick Sandwell, West Midlands, was one of the first schools in England to implement IT-based transformation of learning and children’s services. Rated as “Outstanding” by government inspectors in 2006, particularly for its innovative use of technology, Shireland has seen its “proficient” and “advanced” scores for seniors improve from 23% to 60%. The academy now offers a hosted version of its personalized learning solution to other schools in the country and partner systems overseas.

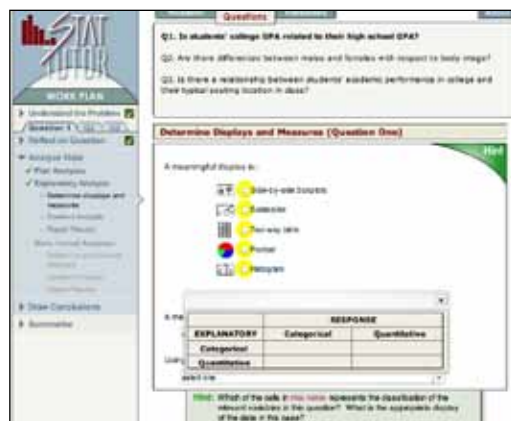
Open University

[The Open University](#) in the UK is regarded by many as a pioneer in the use of digital media to drive student learning and instructional innovation. Its SocialLearn initiative will soon launch a next-generation social media platform, using Web 2.0 business models and tools to enable personalized learning, both for free and for a fee. Already a leader in distance learning, with more than 200,000 students worldwide, the Open University was recently ranked in the top three nationally for student satisfaction for the fourth successive year.

Open Learning Initiative

Using a powerful combination of intelligent tutoring systems, virtual laboratories, simulations and frequent opportunities for assessment and feedback, the [Open Learning Initiative \(OLI\)](#) at Carnegie Mellon University builds

courses with dynamic, flexible and responsive instruction that fosters robust learning. The courses are designed based on research in the learning sciences and can be adopted by other institutions. As students work through the courses, OLI uses technology to collect real-time interaction-level data to create four positive feedback loops for continuous performance improvement: feedback to students, feedback to instructors, feedback to course designers and feedback to learning science researchers. Results from two “accelerated learning” studies conducted on the OLI statistics course showed that students in the course learned a full semester’s worth of material in half the typical time and demonstrated pre- to post-test score gains that were 15% greater than those of students in traditional statistics courses. Furthermore, there was no significant difference in knowledge retention between OLI accelerated and traditional students in follow-up measures taken one or more semesters later.



A screen capture from the OLI statistics course, which has dynamic tutorial and feedback capabilities.

Carl Wieman Science Education Initiative

[The Carl Wieman Science Education Initiative \(CWSEI\)](#) is a five-year, US\$12 million project at the University of British Columbia in Canada that aims to dramatically improve undergraduate science education. Using an



approach that has its basis in research-driven improvements demonstrated in the teaching of introductory physics at the tertiary level, Wieman and his team are demonstrating two-fold improvements in student mastery of core scientific concepts that are critical to advancement in the sciences.

State of Florida

The [state of Florida](#) made an early strategic investment in its longitudinal data store and analytical service, which allows it to track citizens from the moment they enter the education system until they exit the workforce. The data is exposed to researchers who can analyze results, identify issues and formulate changes to the state's allocation of resources.



The Florida Department of Education's data store features an "executive dashboard" that is made available to the governor, the commissioner of education and other high-level policy-makers to help inform decisions on education strategy and budget allocations.

Queensland's Department of Education and Training and the London Grid for Learning

The [Department of Education and Training](#) in Queensland, Australia, and the [London Grid for Learning](#) in the UK are early leaders in a trend toward delivering common educational services via a shared broadband "cluster." Subscribing schools are provided with high-speed connectivity, network services, a common learning platform, online content and a support community staffed by master teachers and technicians. Between them, these two programs reach more than 3,800 schools and close to 1.5 million students.

Tabula Digita, Quest to Learn, and the Games for Learning Institute

Founded in Manhattan's Silicon Alley in 2003, [Tabula Digita's](#) experiential learning systems target pre-algebra and algebra curricula. Using the latest 3-D first-person video game technology, students complete missions by entering reality-based environments in single-player mode or a fast-paced multi-player mode. Also in New York is the [Quest to Learn](#) school, a new 6th through 12th grade public school that will use game-inspired methods to teach critical skills using popular technologies such as Microsoft® Xbox® and its XNA games development environment. Nearby is the [Games for Learning Institute](#) at New York University—a multidisciplinary, multi-institutional gaming research alliance that is gathering scientific evidence to support games as learning tools for math and science subjects among middle-school students.

Elevate America

[Elevate America](#) is a recently launched public-private partnership between Microsoft and U.S. states to provide free access for 1 million Americans to a comprehensive set of e-learning courses and certification exams in both basic and intermediate technology skills. Cities such as Miami and New York have taken the lead in using these assets to target both in-school and workforce skills development by engaging students and their caregivers using a wraparound approach.



On the Lower East Side of Manhattan, one of New York City's poorest areas, the nonprofit Henry Street Settlement offers free access to state-of-the-art computers and technology skills training to more than 2,500 registered local residents.





How We Get There

We can make tremendous improvements in education by embracing software and services that heighten our collective focus on the learning taking place in the nation's classrooms; that enable more evidence-based collaboration and decision making among teachers and service providers; and that reduce the barriers to more proactive involvement by administrators and system leaders.

From a policy perspective, we believe that any systemic educational transformation hinges on six core factors related to technology investment and use:

1. Provide every school, teacher and student with access to the devices, tools and connectivity they need. Access to technology is an important prerequisite for many of the improvements discussed in this paper. Every student and teacher could benefit from access to an affordable device that contains the tools to teach and learn, and every school should be connected with high-speed fiber broadband or with other types of connectivity in rural areas where a landline is not viable.

2. Provide teachers with the support they need to adopt IT-based teaching methods. The success of a student-centered education system depends on teachers who are well-trained both in technology and the new approaches to teaching that it enables. Consequently, traditional and alternative teacher certification programs should be brought up to date, with greater immersion in proven IT-enabled teaching methods. Professional development for teachers should include the same types of technology-based instruction that we are asking them to adopt in the classroom. This investment must include funding of public-private research to develop learning environments that are relevant to 21st-century skills, including the digitization of learning content and artifacts from the nation's museums, libraries and archives.

3. Provide students with digital resources that can enrich their learning experiences and improve their workforce readiness. While many nations have a highly federated structure, we believe that national governments can do more to equip students for success and prepare them for tomorrow's workforce. First, digital literacy or competency must be among the top priorities of education policy and legislation. Second, more can be done to stimulate the market for digital assessment, content and courseware; we urge ministries of education to make use of both public and private funding mechanisms to encourage identification of proven practices that can be scaled across their education systems. Finally, we support the introduction of lifelong digital education records for any learners registered in a nation's education system. We believe that all



learners have the right to know and demonstrate where they stand in their educational journey and workforce preparedness.

4. Equip education systems with the same state-of-the-art data, technology and communications infrastructure that businesses enjoy. Schools should not have to be experts in IT management to take advantage of the communication, collaboration, resource management and business intelligence software that companies use to increase productivity and efficiency. A market is rapidly developing in hosted core education services that can be delivered at higher scale and lower cost than institutions can realize on their own. Governments should ensure that regulations and procurement guidelines enable their education leaders to take advantage of these new services—whether for pooled facilities management, hosted learning environments, or data storage and services. Data on education and learning has incalculable value for current and future generations of teachers and education researchers, so it should be treated as a core strategic asset by government and accorded appropriate levels of investment and governance.

5. Make STEM education an investment priority. To compete and innovate, countries must do more to address the gap in the supply of highly skilled labor. This will require collaboration with the private sector in reappraising approaches to investment in STEM education and the role of STEM subjects in common core or interdisciplinary curricula and qualifications. Governments should also seek to employ a combination of national assessment programs and core standards to stimulate development of more consistent STEM and workforce education at primary, secondary and tertiary institutions. Investments must also be made to ensure an adequate supply of effective STEM teachers who use technology-based instructional methods. Education ministries can increase their odds of STEM success by encouraging formation of new school models and school networks that are chartered to partner with museums, research centers and STEM-based industry partners. Finally, given the importance of computational science in innovation, governments should encourage public-private partnerships that leverage the enormous investments made by industry in cloud computing infrastructure.

6. Adopt an integrated approach to achieving education reform. A 21st-century learning environment does not begin and end at the school door or a campus gate. Learning extends to the home and the local library or community center. There is broad agreement that parental and community involvement raises the probability of success for students. More can be done at the national level to articulate what success looks like in terms of whole-school reform, in which leaders take an end-to-end view of content, curricula, teacher development and IT investment and where elementary to post-secondary is seen as a continuum rather than a series of discrete and unconnected steps.

Achieving a Vision of 21st-Century Learning

This is a crucial time for education. The world is changing, and societal challenges in sectors such as healthcare, energy, the environment and national defense require an increasingly multi-disciplinary response from governments. If we are to meet these challenges, we must change our approach to instruction and the standards to which we hold ourselves accountable. Embracing IT as part of any educational transformation agenda can bring the benefits of a high-quality education to everyone.

At Microsoft, we believe in the power of IT to transform education, but we also recognize from many years of experience working with elementary, secondary and tertiary education systems around the world that IT-driven educational transformation requires a strong and lasting commitment from technology companies and a sustained focus on the primary goal: ensuring that every student has an opportunity to succeed in life, work and citizenship. As part of this commitment, we urge governments to enact technology-oriented reforms that enable this transformation.

To learn more about Microsoft's engagement in education, please visit www.microsoft.com/education.

For the online version of this document and more information about our Public Policy Agenda, please visit www.microsoft.com/publicpolicy.

