New York Smart Schools
Commission Report

www.smartschoolsny.com

October 27, 2014

Dear Governor Cuomo:

As members of the Smart Schools Commission, we are pleased to present you with our Final Report on the state and future of classroom technology and broadband connectivity in New York's public schools and communities, along with a series of Smart Schools Keys to Success for school districts to consider.

You charged the Commission with advising the State, based on research and proven best practices, on how best to invest the proposed $2 billion Smart Schools Bond Act to enhance teaching and learning through technology. While we focused our attention on the proposed Smart Schools initiative, these findings and recommendations can apply to school districts making a targeted investment in technology from any funding source.

This report reflects the input of hundreds of parents, teachers, students, administrators and private sector stakeholders convened in a series of public symposiums, staff meetings, school and facility tours, and through our website: www.smartschoolsny.com. It also incorporates our own ideas about how to reimagine teaching and learning for the 21st century.

This report outlines opportunities inherent in incorporating technology into the classroom. It also provides school districts with a roadmap to plan for and implement a technology-driven overhaul of their schools that enhances student achievement and prepares students to participate in tomorrow's economy.

We thank you for your leadership on this pivotal and timely issue and for including us on the Commission.

Sincerely,

Geoffrey Canada
Constance Evelyn
Eric Schmidt

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I. Executive Summary

In the 1990s, technology in the classroom meant mimeograph machines, tabletop projectors and transparencies, and VCRs. It was a big deal when a school had a shared computer lab where kids learned not only word processing but also how to use the computer.

We've come a long way since then. Our children are digital natives. Many learn how to swipe the screen of a smartphone before they can walk. In some cases, they are the ones teaching adults how to use the latest technology and they adapt to new technologies without a second thought.

It is time to modernize our facilities and classrooms so educators, students and parents can fully leverage technology to enhance educational achievement.

> *"Leveraging technology to support instructional practice and professional development is crucial to ensure Americans have access to a high-quality education and are prepared to be globally competitive. Schools, educators, students, and families all benefit when effective digital tools and materials are thoughtfully integrated into classrooms and communities."*
>
> ~ U.S. Department of Education[1]

Technology has the potential to increase student engagement and responsibility for learning, boost student achievement, and change student-teacher relationships. Importantly, technology also helps students gain the skills they need to compete for in-demand jobs in the 21st century economy.

Technology has the power to break down barriers – between parents and teachers, homes and classrooms, and between school districts across the State. It can facilitate increased interaction between students, parents, and teachers, and help extend learning beyond the school day and into the home. Technology also enables teachers to access training through online venues and can elevate the caliber of even the most experienced teachers. Furthermore, equipping all students with up-to-date tools is essential to ensure that New York State's students develop the skills they need to become competitive participants in the 21st century economy.

The $2 billion Smart Schools Bond Act has the potential to provide capacity for schools and classrooms to meet the demands of the 21st century, help students achieve and teachers teach, and ensure that New York's students graduate with the skills they need to thrive. The Commission was tasked with helping to maximize school districts' potential use of future bond funds, should the act be approved by voters. The Keys for Success set forth in this report represent the Commission's findings on what steps districts should take to best optimize the use of potential Smart Schools funds in order to drive student achievement.

II. The Keys to Success for Achieving a Smart School

1. Embrace and expand online learning which will break down geographic barriers, provide access to the best sources of instruction in the world, and level the playing field for students in rural and smaller school districts.
2. Utilize transformative technologies, such as tablets, laptops, and interactive whiteboards to deliver differentiated instruction tailored to students' specific abilities and needs that lets them learn and advance at their own pace.
3. Connect every school to high-speed broadband using technology that is capable of scaling up over time and deliver sufficient wireless capability to serve every student.
4. Extend connectivity beyond the four walls of the classroom so students from all backgrounds have equal access to the information superhighway.
5. Provide high-quality, continuous professional development to teachers, principals, and staff to ensure successful integration of technology into the teaching and learning experience.
6. Focus on in-demand STEM skills to ensure that students graduate with 21st century skills.
7. Plan, plan, and plan again.

III. Introduction

New York State is in the midst of an education reinvention, as it moves toward replacing an outdated 1950's bureaucracy with a performance-oriented organization geared for the future. In addition, the State has made great strides in supporting our schools with increased funds and innovative new programs. As part of this commitment, over the last three years, the State has increased funding for education by $2.9 billion. The Fiscal Year (FY) 2014-15 enacted budget included a $1.1 billion increase, bringing State education funding to its highest level ever.

To ensure that funds are used effectively, in 2012 the Governor established the *New* NY Education Reform Commission, a group of nationally recognized education, community, and business leaders, tasked with making recommendations for future reforms in education. The State has already acted on several of their recommendations, investing in high-needs school districts and using competitive performance grants to reward student achievement and management efficiency.

Student Achievement

Research shows that the delivery of quality early education is one of the most effective interventions in a student's long-term academic success.[2] New York State has been a leader in early education, investing $385 million a year in half-day Universal Pre-Kindergarten. In 2013, building on this foundation, the State provided $25 million in competitive grants to support expansion of full-day pre-kindergarten. In 2014, after seeing the success of these programs, the State made a $1.5 billion five-year commitment to phase in universal full-day pre-kindergarten statewide. Additionally, as part of the FY13-14 enacted budget, the State invested $20 million in *Extended Learning Time,* a competitive grant program to support high quality extended-day or school year programs. To boost family engagement, the State launched *Community Schools,* an innovative program to transform schools in distressed communities into hubs for a wide range of support services for children and their families, including health care, counseling, nutrition services, and job preparation services.

To ensure the continued success of New York students in tomorrow's economy, the State has also focused on a set of initiatives to prepare students to launch careers in high-growth sectors such as engineering, advanced manufacturing, and technology.

New York State brought together business, higher education, and K-12 schools to create a statewide initiative to prepare students for high-skill jobs in the Science, Technology, Engineering and Math (STEM) fields. *New York State's Pathways in Technology Early College High School Program (NYS P-TECH)* provides high school students with a mentor and an associate's degree at no cost, and puts them first in line for jobs at partnering businesses when they graduate. In addition, the FY14-15 enacted budget includes $5 million to add additional schools to the NYS P-TECH initiative, preparing more than 6,000 New York students for jobs of the future in technology, manufacturing, healthcare, finance, and other growth sectors.

To encourage the best and brightest students to build their future in New York and to help employers fill critical positions that require math and science skills, the State created a new *STEM Scholarship* program for the top 10%

of students in each high school. These students will receive full tuition scholarships to any SUNY or CUNY college or university if they commit to pursue a STEM career and work in New York for five years.

New York has also instituted rational tuition pricing for SUNY and CUNY colleges, through the *SUNY 2020* legislation, keeping higher education affordable. To connect students to jobs once they graduate, the *NY Job Linkage* program connects community college degrees and certificate programs with improved local opportunities for post-graduation employment. Other programs, such as *Start-Up NY,* have further harnessed opportunities to spur economic development across New York through initiatives tied to local academic institutions.

School Accountability

Studies show that teachers account for one-third of a school's total impact on student achievement and principal leadership accounts for another 25% of that impact.[3] To guarantee New York State's education pipeline has the best teachers and principals, the State has embarked on several initiatives to bring greater accountability into the classroom and recognize high-performing educators. For the first time, every New York school district now has in place a meaningful *Teacher Evaluation System* with rigorous performance-based measures to assess how students are learning. School districts must evaluate all teachers and principals on an annual basis, armed with tools to reward performance and put the interest of the students above the interests of the bureaucracy. Ratings are calculated using State test results, local assessments and other measures.

To reward and retain the State's highly effective educators, New York established the statewide *Master Teachers* program to award stipends of $15,000 per year over four years to reward high-performing K-12 teachers in math and science and related fields. The State has also raised the bar for admission to teacher and principal preparation programs offered by SUNY and CUNY in order to recruit teachers from the top of their class. Both institutions have adopted resolutions to implement increased admission standards for incoming students.

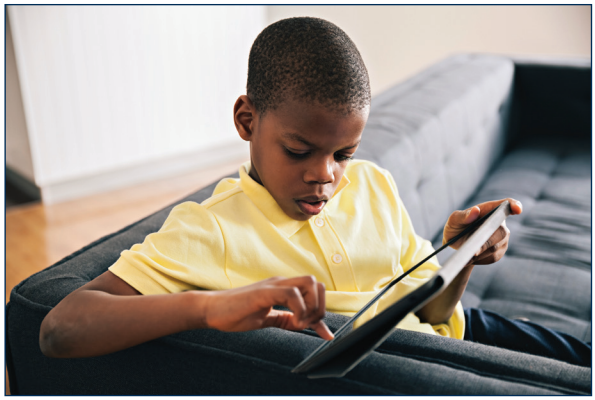
Along with its targeted focus on student achievement, the State is building a strong foundation for academic success. New York State's investments in students and teachers shift the focus from traditional bureaucracy to fundamental reform that gives early access to high-quality programming, bases funding on performance, incentivizes success, and provides new pathways to college and career readiness. The next step on this journey is critical for success in today's 21st century economy.

The Commission recommends that the State must reinvent its classrooms with new technology that provides individualized learning and promotes greater access and equity by bringing new opportunities to socioeconomically and geographically diverse students.

The Next Step:
Giving Students and Schools the Infrastructure and Technology to Succeed

While New York State is on the cutting edge of innovation and technology in many areas, schools throughout the State remain stuck in the past. To transform our classrooms from the classrooms of yesterday to the classrooms of tomorrow, we recommend that the State make strategic investments in digital learning. By incorporating equipment such as laptops, desktops, and tablets, infrastructure upgrades to our schools, and high speed broadband, the State can give teachers the tools to teach and students the foundation to learn. These new technologies can help to give every child the opportunity to learn at his or her own pace and get the skills they need to succeed within the 21st century economy. Additionally, improvements in technology can be used to increase the frequency of communication between parents and teachers, give access to a range of learning resources, and offer teachers further assistance and training through online venues.

As part of its work, the *New* NY Education Reform Commission noted that technology could significantly improve student performance. They recommended expanding the use of technology in schools, especially highest-need schools, through investments in hardware and broadband infrastructure.



Such investments will serve to complement teaching and academic programs, allowing school districts to leverage the power of technology to better serve today's students. To best use technology in a transformative way, the Commission stressed the need for the State to pursue a tailored strategy, since simply requiring that specific technologies be pursued statewide would not be prudent. Rather, they recommended that the State take steps to help districts make wise technology investments that address their unique needs.

To build out schools and classrooms for the 21st century, help students achieve and teachers teach, and ensure that New York's students graduate with the skills they need to thrive, the 2014-15 Enacted Budget included a $2 billion Smart Schools investment in education technology to be brought before voters in November 2014. If approved, every school district would receive funding that can be used for technology investments such as tablets, laptops, interactive whiteboards, wireless Internet access, and high-speed broadband connectivity. In addition, the Smart Schools bond would enable long-term investments in full-day pre-kindergarten through the construction of new pre-kindergarten classroom space, would allow districts to replace portable trailers with permanent classroom space, and would enable districts to install school safety and surveillance systems.

> "Experts have said that technology has the potential to be the great equalizer, as it is constantly evolving to remove traditional barriers to learning and mobility. For some schools the most sophisticated piece of electronic equipment is the metal detector that you walk through on the way to the classroom. The children of New York deserve better. Let's reimagine our classrooms for the next generation, let's have the smartest classrooms in the nation because our children deserve nothing less than the best."
>
> ~ Governor Andrew M. Cuomo, 2014 State of the State Address

To best maximize districts' Smart Schools investments, in spring 2014 the Governor launched the *Smart Schools Commission* to provide recommendations based on best practices in technology-enabled education and broadband connectivity. Over the course of five months, the Commission consulted with stakeholders from across the education and technology communities, including technology experts, teachers, parents, students, employers, and innovation leaders. This collaborative effort exposed the Commission to best practices around the State and nation and drove the creation of our recommendations to the Governor. This report presents the Commission's overall findings on how districts can best optimize the use of Smart Schools funds.

IV. Part One: Technology-Enabled Teaching

Educators have long-endeavored to meaningfully integrate technology in the classroom. From movies to slide projectors to radio, television, VCRs, computers and the Internet -- all have contributed to the enhancement of teaching and learning.

It is critical for educators and administrators to keep up with the technological revolution and incorporate it into our classrooms. As technology continues to evolve, it stands to play a greater role in education, significantly impacting how learners are able to access knowledge and information as well as interact with their teachers and one another. More than just a set of instructional add-ons or classroom props, when used systematically, technology has the capability to transform the current system of teaching and learning. Technology can promote a shift from traditional pedagogical practices to those that foster collaborative teaching strategies and student-centered learning, as well as a shift from fragmented approaches to curriculum and instruction to those that utilize an integrated platform that can be managed and accessed from anywhere at any time.

Partnering for Success

The success of an educational environment depends on making sure that all of the relevant players are working in sync with one another: teachers, parents, students, and administrators. Technology helps to create and grow these relationships and ensure that this process runs smoothly and efficiently.

In its 2010 National Educational Technology Plan, the United States Department of Education advocates for leveraging technology to advance the concept of "connected teaching."[4] Connected teaching turns teaching into a team activity, where the team is comprised of fellow teachers, students and their peers, subject matter experts around the world, and parents. Connected teaching is effective and efficient and expands the universe of learning resources and options for our students.

Research has shown over time that student success hinges on the degree of parent participation.[5] Technology allows teachers to move beyond periodic written report cards and occasional parent-teacher conferences to a system of continuous updates via website or classroom blog, email, or learning management system. Teachers can also solicit and respond to feedback from parents via these same mediums. In addition, technology can help schools improve engagement with limited-English families and communities through multi-language channels and the use of translation services.

Additional ways technology can enhance engagement among teachers, students, and parents:

- Teachers can share photos and videos of a student's art project or performance, homework assignments and grades on an ongoing basis. And parents can know, in real-time, how their student is doing before it's too late to change course.
- Using online connections in the classroom and at home, students can share their work and communicate with one another more productively and creatively. They can collaborate on group projects without needing to be in the same room.
- Teachers can maintain records and assessments using software tools and stay in close touch with students and families via email and voicemail. And schools can reduce administrative costs by using technology tools, as other fields have done, freeing up additional funds to spend on the classroom experience.
- Technology also makes it easier for teachers to collaborate with one another online. Using tailored social networks, teachers can trade resources and tips with other educators, learn about best practices in education, and get instant feedback on a specific instructional approach or tool.

The intelligent use of technology can transform and improve almost every aspect of school, modernizing the nature of curriculum, student assignments, parental connections, and administration. In fact, online curricula now include lesson plans, simulations, and demonstrations for classroom use and review. Technology has the potential to transform the joint student, teacher, administrator, and parent experience.

Learning Management Systems

Technology allows teachers to maintain records and assessments using various software platforms. Learning management systems are software applications that are used to administer, document, track, report, and deliver instructor-led and e-learning education courses. They are an important enabling technology for access to learning content and administration at anytime from anywhere. With the extraordinary growth of information, increase in student diversity, introduction of new learning theories, and Internet access being more readily available, learning management systems have become an increasingly popular mechanism to help teachers provide more student-centered teaching and learning experiences.[6]

There are a number of advantages to using learning management systems. In addition to providing flexible access to learning opportunities, they foster motivation, encouraging students to become more independent and self-directed learners. Learning management systems can also facilitate deep processing, build the whole person, cater to individual differences, promote meaningful learning, encourage interaction, provide feedback, facilitate contextual learning, and provide support during the learning process.[7]

Integrating Technology and Pedagogy

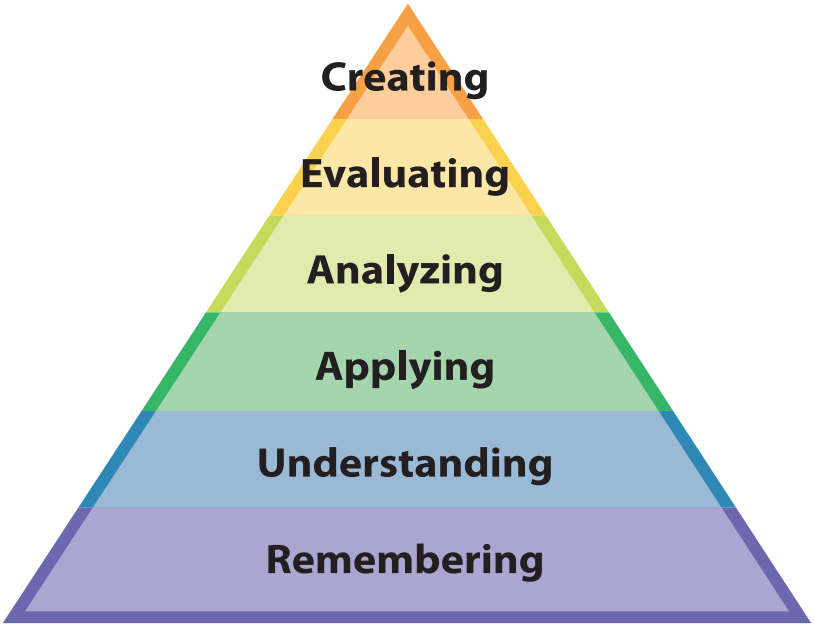
Technology integration does not equate to students visiting a computer lab to learn technical skills while the teacher stays behind. Integration does not exist when classrooms have carts of unused tablets or an interactive whiteboard that is only being used as a replacement for a chalkboard. Technology integration occurs when teachers use technology to introduce, reinforce, enrich, extend, and assess student mastery of curricular goals.[8]

The Common Core Learning Standards explicitly advocate the integration of technology in teaching and learning.[9] Not simply as a mechanism to engage students, the Standards require teachers – and students – to make complex decisions about when, why, and how to use technology to access, create, and share information.

Indeed, the Common Core Learning Standards expect students to do more than just acquire knowledge; rather, they aim to enhance the ways students think and are able to clearly articulate their understandings of this knowledge. In fact, the Standards promote student growth and development at the higher levels of Bloom's Taxonomy, emphasizing analysis, evaluation, and creation. The integration of technology further engages students, enabling and empowering them to acquire deeper understandings of new knowledge.[10]

1. Bloom's Taxonomy

Bloom's Taxonomy is a classification system developed in 1956 by education psychologist Benjamin Bloom to categorize behavior and intellectual skills important to learning. Originally used to classify educational goals for student performance evaluation, it has been revised over the years and is still used today. It is comprised of six taxonomy categories, and organizes thinking skills from the most basic to the more complex. The hierarchical nature of the taxonomy is meant to convey that mastery of the simpler category is essential to mastering the next, more complex one.



Source: http://www.learnnc.org/lp/pages/4719

Within each level of the taxonomy, there are various tasks that move students through the thought process:

- *Remembering:* recalling information; recognizing; listing; describing; retrieving; naming; finding.
- *Understanding:* explaining ideas or concepts; interpreting; summarizing; paraphrasing; classifying.
- *Applying:* using information in another familiar situation; implementing; carrying out; using; executing.
- *Analyzing:* breaking information into parts to explore understandings and relationships; comparing; organizing; deconstructing; interrogating.
- *Evaluating:* justifying a decision or course of action; checking; hypothesizing; critiquing; experimenting; judging.
- *Creating:* generating new ideas, products, or ways of viewing things; designing; constructing; planning; producing; inventing.[11]

By utilizing Bloom's Taxonomy in the classroom, teachers can develop learning strategies that are most appropriate, effective, and efficient for their students. They can also assess students on multiple learning outcomes aligned to local and State standards and objectives. The integration of technology promotes and extends student learning, offering them not only the tools but skills to succeed as 21st century learners. What's more, the utilization of technology along with Bloom's Taxonomy helps students become creators and critics, as opposed to just consumers.

Examples of activities that integrate technology along the Bloom's Taxonomy continuum:

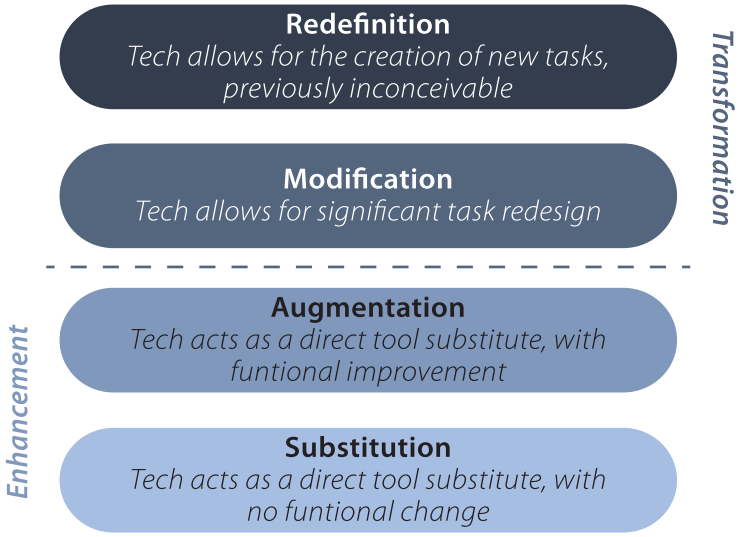
- *Remembering:* using social bookmarking tools; highlighting; favoriting; querying.
- *Understanding:* (while bookmarking) tagging, summarizing, and commenting on the resources located; advanced searching; blog journaling .
- *Applying:* running and operating programs; playing games; uploading and sharing; editing.
- *Analyzing:* completing a project using a web application, and making connections within that project.
- *Evaluating:* teacher posts student projects on a blog or other mechanism to facilitate digital conversations and have other students comment on the projects, using a well-defined rubric.
- *Creating:* collaborating on a project that is published to a web-based sharing application.[12]

To assist teachers with more effectively leveraging technology in their teaching, a shared focus on Bloom's taxonomy and the SAMR (Substitution Augmentation Modification Redefinition) model, explained below, will be helpful. In particular, this focus encourages teachers to (1) create tasks that target higher-order thinking skills and (2) design activities that have meaningful impacts on student outcomes.

2. SAMR

The SAMR (Substitution Augmentation Modification Redefinition) model is a framework used to describe technology integration. Developed by Ruben Puentedura in collaboration with the Maine Department of Education and their learning technology initiative, it has gained increasing popularity as a mechanism to help teachers evaluate their use of technology in their classrooms. As with Bloom's Taxonomy, stages are presented along a continuum, each stage highlighting a more complex utilization of technology.

In the first two stages – substitution and augmentation – technology acts as a direct replacement for the original tool, with little to no purposeful change or improvement in the teaching and learning experience. In the third and fourth stages – modification and redefinition – technology profoundly alters all or part of the task/assignment, providing students with an enhanced educational experience.[13]



Source: Ruben R. Puentedura, As We May Teach: Educational Technology, From Theory Into Practice. (2009)

In effect, the SAMR model illustrates that technology should not be used simply for the sake of using it; rather, it should be thoughtfully integrated to provide students with transformative learning experiences. Generally, technology integration begins at the lower stages and progresses upward. It is important to note, however, that just as with Bloom's Taxonomy, the goal of the lesson should dictate the stage of technology inclusion; there is nothing inherently wrong with teaching at the lower stages, nor is it always better to teach at the upper stages. The aim is to align the tools and processes used with the desired level. It must also be noted that, though many of today's students are adept at using technology, a range of comfort and facility with technology may still exist within the classroom. As with Bloom's Taxonomy, teachers are asked to meet students where they are and support their advancement along the continuum.

Another central tenet of Bloom's Taxonomy and the SAMR model is that students learn best when they are engaged in meaningful learning activities where they are given the opportunity to learn from each other and share their ideas and thinking with others. A dynamic teaching method that similarly supports these goals is project-based learning.

3. Project-Based Learning

Project-based learning is an approach to teaching that involves students in sustained, collaborative investigations, organized around a complex question, problem, or challenge. The most effective projects encourage students to: tackle real problems and issues that have importance to people beyond the classroom; actively engage in the learning experience and make important choices during the project; and demonstrate in tangible ways that they have mastered key concepts and skills.[14] The project-based learning approach is not new; however, innovations in educational technologies have enhanced its implementation.

Indeed, technology integration lends itself to project-based learning. To begin, it allows all students – at all levels – to participate in deep, authentic learning experiences. The integration of technology also facilitates personalized learning experiences, creating classroom environments that emphasize inquiry, teamwork, and shared expectations for student work. In addition, it helps students to internalize ideas and create situations where skills and concepts can be applied in different contexts to explore and synthesize new knowledge.[15] Further, project-based learning utilizing technology allows students to employ and demonstrate their diverse intelligences in different ways.

Project-Based Learning Resources

The following websites offer examples of project-based learning projects that utilize technology:

- **Edutopia.** Includes in-depth research on project-based learning as well as examples, blogs, and much more.
- **Buck Institute for Education.** Offers a deep look into project-based learning, including research and examples of projects.
- **High Tech High.** High Tech High teachers documented the success of their project-based learning efforts to share with other educators.
- **Journey North.** Allows K-12 students to engage in global studies of wildlife migration and seasonal change while sharing their own field observations with classmates across North America.

V. Part Two: Technology-Enabled Learning

Technology offers a way to rethink and redesign the ways that we are able to serve the State's learners, who possess a diversity of needs and abilities. As Randy Kerr, a longtime member of the Newark Valley Central School District Board of Education, testified before the *New* New York Education Reform Commission:

> Technology does not care if students are all at different places in a subject's curriculum. Technology does not slow some down so that they do not get too far ahead. Technology does not care about spending as much time as necessary to assist students with particularly difficult concepts. Technology provides another tool for our educational environment to provide individual, differentiated teaching for the wide range of student abilities.[16]

Technology allows us to put learners at the center of their education, empowering them to take charge of their own learning by providing flexible, personalized learning experiences. E-learning systems, for example, track students' learning needs and provide a platform to access a broad array of content, resources, and instructional opportunities tailored to these needs – some or all of which may not be available within the school building. What's more, students are able to master academic skills at their own pace, regardless of time or place.

Key to Success #1: Embrace and expand online learning which will break down geographic barriers, provide access to the best sources of instruction in the world, and level the playing field for students in rural and smaller school districts.

Online Learning

Online learning has its origins in the tradition of distance learning, which included earlier technologies such as correspondence courses, educational television programming, and videoconferencing. The advent of the Internet, however, broadened the potential for reaching learners – and information – around the world. Today, online learning provides instructional resources and experiences in multiple media, and has the capability to support real-time and asynchronous communication between teachers and learners as well as between learners themselves.[17]

As one of the fastest growing trends in the educational uses of technology, online learning has become an increasingly significant component within the K-12 sphere. Often utilized as an alternative way to offer courses, academic credits, and support toward high school diplomas, online learning programs also increase student access by making a wide range of high-quality courses and instructional materials available to students. A recent report found that 30 states and over half of U. S. school districts offer online courses and services.[18] Further, the National Center for Education Statistics (2012) reported that in the 2009-10 school year, over 1.8 million K-12 public school students were enrolled in a technology-based distance education course.[19]

The New York State Education Department has launched an initiative to support the growth of a statewide virtual learning network.[20] In conjunction with higher education, the aim of this initiative is to harness the capacity and needs of districts, charters, and BOCES across the State to develop and implement expanded learning opportunities for students. In particular, it promotes the development of effective online and blended instructional approaches, which have been found to increase student engagement, improve educational productivity by accelerating the rate of learning, and better utilizes teacher time.[21]

One of the reasons online learning has gained such popularity is because it allows for more flexible access to curriculum and instruction. This typically involves: increasing the availability of instructional experiences to learners who are unable or choose not to participate in traditional, face-to-face settings; enabling teachers to reach more students while maintaining quality in teaching and outcomes comparable to that of traditional delivery of instruction; and/or gathering and providing academic content in a more cost-efficient manner.[22] The flexibility of online education also provides distinct advantages to smaller/rural districts, in many ways helping to level the educational playing field. For instance, it permits them to provide expanded curriculum options to their students beyond the courses offered directly in the school building. In rural communities in particular, online learning also breaks down geographical barriers, enabling students to expand their perspectives and social connections through virtual field trips and collaborative projects with students from around the world.

As there are numerous types and structures of online learning programs – e.g., supplemental, full-time, district-led, state-led – there are also numerous approaches to teaching, learning, student support, and professional development. Blended learning is one such exciting approach.

Colton-Pierrepont Central School

Colton-Pierrepont Central School District is a small rural school system located in the foothills of the Adirondack Mountains. The District currently has 324 geographically dispersed students enrolled; 41% are free and reduced price lunch recipients and almost 16% are learning disabled. Given the District's belief that technology is critical for all 21st century citizens, they have embraced new ways of finding, presenting, and transferring information and helping students to understand the advantages, limitations, and possible dangers of the current and emerging technologies.

As part of their efforts to proactively engage in technology-based learning, in 2009 the District began the process of developing a 1:1 Laptop Program. A team of stakeholder representatives was convened to research and investigate options and best practices, infrastructure was upgraded to support additional loads of student devices, and teachers were provided laptops and professional development for integrating technology into curriculum. By 2011, devices were rolled out to students for use in the classroom and at home, and by 2013 every student from Pre-K through the 12th grade had regular exposure to these technologies.

Further, given the fact that many students have long commutes to and from school, the District installed 4G WiFi on school buses this year in an effort to extend the time students have to learn. Now that the digital infrastructure and culture has been fully established, the District has shifted focus to professional development and external collaboration to further progress.

Colton-Pierrepont attributes the success of their 1:1 Laptop Program to the following factors:

- Stakeholder involvement
- Initial research and extended project planning time to avoid pitfalls
- Infrastructure investment up front
- Building culture by starting with teachers
- Choice of platform and devices to minimize issues and distractions
- Involving parents to create a sense of ownership
- Continued investment in professional development

Blended Learning

Blended learning refers to a combination of supervised, face-to-face instruction – including, but not limited to, lectures – and online learning. It is often utilized to accommodate students' various learning styles, allowing them to complete coursework in ways that are not possible with traditional, full-time classroom instruction. The majority of blended learning programs resemble one of four models: rotation; flex; a la carte; or enriched virtual.

- *Rotation* – students rotate on a fixed schedule or at the teacher's discretion between learning modalities, at least one of which is online learning. The other modalities may include activities such as small-group or full-class instruction and group projects. This model includes the flipped classroom approach where students replace a course's homework with online learning at home and teacher-guided projects or projects at school.
- *Flex* – students move on an individually customized, fluid schedule among learning modalities, the backbone of which is online learning. The supervising teacher provides face-to-face support on a flexible, as-needed basis through activities such as small-group instruction, group projects, and individual tutoring.
- *A La Carte* – a course that a student takes entirely online to accompany other experiences that he or she is having at a brick-and-mortar site. Students may take the a la carte course either on the brick-and-mortar campus or off-site. This differs from full-time online learning because it is not a whole-school experience; students take some courses a la carte and others face-to-face at a brick-and-mortar campus.
- *Enriched Virtual* – students have required face-to-face learning sessions with their teacher of record and then are free to complete their remaining coursework remote from the face-to-face teacher. This differs from a fully online course because face-to-face learning sessions are required, as opposed to optional participation in office hours or social events.[23]

As schools work to enhance student success and increase accountability, blended learning is playing an increasingly important role in education, as schools and districts are rethinking the structure and delivery of curriculum and instruction. In fact, a growing number of schools have begun to introduce blended learning into their core instructional programming for mainstream students, not just those in need of additional educational opportunities.[24]

Below are some examples of how online and blended learning approaches are leveraging technology to provide students with expanded, personalized educational opportunities:

1. Advanced-level Coursework

One of the major draws of online learning is that it allows students to access broader educational opportunities than are otherwise available in their district, such as advanced-level or specialized coursework. In this way, students are given the chance to pursue more challenging coursework. Schools are also able to provide students with learning experiences in a wider range of areas of study without being limited by course enrollment numbers.

For example, the Iowa Online Advanced Placement Academy (IOAPA) delivers Advanced Placement courses to high school students across the State of Iowa. During the 2012-2013 school year, the completion rate for all IOAPA courses was 84%. The passing rate in spring 2013 was 100%.[25] The Virtual Advanced Placement Program, a New York State Education Department initiative, provides school districts and BOCES with grants to increase the successful participation of lower socioeconomic status students in virtual Advanced Placement courses. Not only does this program increase the number and diversity of students who participate in Advanced Placement courses and tests, but it also helps to build and strengthen the capacity of districts and BOCES to provide and expand virtual learning opportunities.

2. Online Tutoring

As with other means of online learning, online tutoring offers a number of advantages. It can be made available during or after school and accessed from school, home, or other locations. In addition, online tutoring providers may cover a broader range of academic content areas and grade levels than can be offered by an individual tutor. Further, synchronous (real-time) online tutoring allows tutors to provide immediate feedback.

3. Credit Recovery

Credit recovery is a term that refers to a student passing – and obtaining credit for – a course that was previously taken but was unsuccessful in receiving academic credit toward graduation. In general, credit recovery programs are primarily aimed at helping students remain in school and graduate with their incoming cohorts.[26] A number of school districts have expanded their online programs to target students interested in credit recovery.

For example, California's Sacramento City Unified School District has on online credit recovery program: the Sacramento Accelerated Academy (SAA). Students enrolled in the SAA complete their coursework in a computer lab setting, assisted by on-site teachers as well as online teachers who can be accessed remotely via the Internet.[27] The Oneida-Herkimer-Madison BOCES in New York also offers an online credit recovery program for students who have either (1) not passed a course or (2) passed a Regents-level course but did not pass the accompanying Regents exam and need a review of the course content. Students register for a self-paced, online course that is facilitated by a New York State teacher who is certified in that particular subject area.

4. Virtual Schools

While online learning as a whole is rapidly expanding, full-time virtual schools are gaining particular attention. Virtual schools are those in which all instruction is delivered via the Internet and electronic communication. Students usually participate at home and teachers are at remote locations. Virtual schools have become one of the fastest-growing forms of schooling options in the country, with a growing number of state education agencies and school districts starting full-time virtual schools.

The Florida Virtual School (FLVS)[28] is the country's first and largest online public school district, serving students in grades K-12. Courses are free for students who are state residents; non-Florida residents are able to take courses on a tuition basis. School districts can also work with FLVS to provide students with blended learning opportunities, enabling them to access online courses from school sites. The Campbell County Virtual School,[29] a K-6 online public school in Wyoming, provides families of enrolled students with computers as well as a subsidy to offset the cost of Internet access. Families are also supplied with CDs, videos, and other instructional materials and resources to accompany the interactive aspects of the online program.

Key to Success # 2: Utilize transformative technologies, such as tablets, laptops, and interactive whiteboards to deliver differentiated instruction tailored to students' specific abilities and needs that lets them learn and advance at their own pace.

Differentiated Instruction

Differentiated instruction is an approach to teaching that considers and respects students' different learning needs. It focuses on teaching strategies that give students multiple options for accessing, processing, and demonstrating understanding of academic content and skills. Instructional technology supports this type of instruction, in addition to providing personalized learning environments that allow students to interact with software, engage in research, produce artifacts, and communicate with others outside of the classroom. Both differentiated instruction and technology tools are important mechanisms for promoting student success in the digital age.[30]

The incorporation of technology into differentiated instruction helps teachers to pace lessons appropriately for each student's learning level, promotes academic growth, and enhances student motivation. In *Differentiated Instruction Using Technology* (2005), Amy Benjamin highlights six additional features of technology that support differentiated instruction:

1. *Privacy:* Technology affords the privacy that is required in order to support the self-esteem of students who are working on a task that is considered by the rest of the class as "too easy."
2. *Collaboration and communication skills:* Online technologies, such as email and discussion boards, encourage communication and collaboration among students, which are essential elements in forming and maintaining learning communities.
3. *Organization:* A number of software options helps students organize their work (e.g., create graphs and outlines) based on their interests and needs.
4. *Learning styles and sensory learning:* With the availability of words, images, sounds, and feedback by others, technology encourages visual, auditory, and social learning, and therefore encourages students of different abilities and interests to participate in the learning process.
5. *Choices:* Internet and software technologies offer students a wide range of activities that can address the various skills and interests found in classrooms.
6. *Authentic learning:* The project-based activities that are usually found in good quality software and Internet sites support authentic learning and constructivist instruction, which are important aspects of differentiated instruction.[31]

With the abundance of software and hardware tools available, teachers are now able to access more resources to help them address the diverse needs of their students. Technology also allows them to attend to these needs in numerous ways, through learning activities, content input, and opportunities to demonstrate understanding. What's more, since many students already come to school with a predisposition for using it easily, technology can bridge the relationship between teachers and their students, allowing them to meet in a familiar space.[32]

Helping All Learners

Technology can help to motivate and engage students to learn, no matter their background, disability or language skills. In fact, a number of early innovations in educational technology emerged from a desire to help students with various learning and physical disabilities overcome obstacles to success in school. For example: communication devices provided a way for students physically unable to speak to communicate; alternate keyboards and touch screens were introduced to improve physical access to the computer; and text readers offered auditory reinforcement for struggling readers and the visually impaired. Assistive technology allows for students with disabilities to participate in general education classrooms, exploring and expanding their potential in ways that were previously not possible.[33]

Learning Disabilities/Assistive Technologies

With the support of certain tools and techniques, students with learning disabilities are able to compensate for difficulties they may have with reading, writing, spelling, math, organization, or memory. These assistive technologies support their efforts to accomplish certain tasks by helping them to learn specific material or perform specific functions. Further, they are intended to help increase the success and motivation of students with learning disabilities, enabling them to acquire greater independence as learners.

Assistive technologies for people with learning disabilities can be as simple as highlighters, calculators, tape recorders, or color-coded files or drawers. Complex or high-tech assistive technology devices include: computers with print-recognition software that 'read' text aloud; speech recognition systems that turn oral language into written text; talking calculators; and software that predicts and edits words.[34] Through the aid of these devices, learning opportunities for students with disabilities are expanded, promoting a more positive classroom environment.

Software to Assist Students with Learning Disabilities

- **Dragon Dictation:** Speech-to-text for a variety of mobile applications (e.g., messaging, emailing, blog writing)
- **ModMath:** Designed for individuals with dyslexia and dysgraphia for whom the mechanics of writing math problems causes a barrier. ModMath takes care of the construction of, for example, the long division problem. After that, solving that problem is up to you.
- **Notability:** Takes "handwritten" notes on documents to allow for adding sketches to PDF or graphics or editing student work. It also has an audio recording feature for auditory learners, photo capability, and it coordinates with sharing platforms.
- **StoryVisualizer:** Creates storybooks for students using their words and images.
- **UsTyme:** Allows two people to remotely read a story together by coupling video-enabled software with reading.
- **DyslexiaQuest:** A series of games designed to "assess working memory, phonological awareness, processing speed, visual memory, auditory memory and sequencing skills." Gamers are encouraged to keep practicing to master skills.
- **Read2Go (iOS) or Go Read (Android):** Makes books accessible to people with print disabilities.

English Language Learners

English language learners represent the fastest-growing group throughout all levels of schooling in the country. Given the often text-dependent nature of subject area content texts and other instructional materials, meeting the needs of such students can be especially challenging. And though many English language learners have had formal education experiences, they may have had little to no exposure to the structure and vocabulary of academic English. Even the strongest English language learners may be held back by a lack of understanding of English syntax and vocabulary.[35]

With the assistance of technology, teaching and learning experiences for English language learners have been enhanced, helping them to achieve academic success. In particular, technology has been found to accelerate the acquisition of phonics, increase vocabulary, improve fluency and reading comprehension skills, and encourage language building block acquisition.[36] For example, text-to-speech software – initially designed for visually-impaired students or students with learning disabilities – has been found to benefit students with a broad range of learning needs, including English language learners. Innovations in this form of technology also offer an efficient way to provide these students with individualized instructional support.[37]

In particular, English language learners benefit from the reinforcement of concepts and vocabulary through pictures, graphics, and video. This inclusion of multimedia technology provides them with the necessary context clues to understand new or unfamiliar ideas and language. Visual information also offers a bridge between everyday language and more challenging academic language. In addition, technology allows English language learners – and all students – to demonstrate mastery of concepts and skills in multiple ways, providing a more accurate representation of their academic growth.[38]

As with many students, English language learners also benefit from being able to use technology to express themselves. For instance, social networking mechanisms such as discussion boards are especially helpful as they (1) allow these students to participate in experiential learning experiences and (2) promote collaboration with other students. Discussion boards also create a platform whereby students are able to engage in using everyday and academic language outside of the classroom.[39] Furthermore, games and simulations have also been suggested as meaningful tools to help English language learners acquire the concepts and skills necessary to improve their academic achievement.

Game-Based Learning

Game-based learning is an instructional method that incorporates educational content or learning principles into video games. It is designed to balance subject matter with gameplay, assessing the ability of the player to understand and apply the subject matter to the real world. As such, game-based learning has the potential to engage and inspire students, offering them custom learning experiences in addition to providing practical experience and promoting long-term memory. The increased development of vocabulary skills and enhancement of mental dexterity are also benefits of this instructional approach.

Research indicates that computer games succeed as educational devices because they provide extended exposure to concepts through re-playability, contextualize educational information, teach problem solving skills, develop multi-player socialization, and allow players to be producers and not just consumers.[40] As Shafer et al. (2005) explain:

> In game worlds, learning no longer means confronting words and symbols that are separated from the things those words and symbols refer to. In virtual worlds, learners experience the concrete realities that words and symbols describe. Through these and similar experiences in multiple contexts, learners can understand complex concepts without losing the connection between abstract ideas and the real problems they can be used to solve. In other words, the virtual worlds of games are powerful because they make it possible to develop situated understanding.[41]

The interactive nature of video games also stimulates learning and encourages students to take on new challenges, exploring and utilizing new knowledge and skills. Furthermore, game-based learning provides yet another way to personalize learning, offering expanded access to educational opportunities.

Quest to Learn is an innovative public school in New York City for grades 6-12 that incorporates game-based learning to teach students traditional subjects.[42] In partnership with the Institute of Play at Parsons The New School for Design, Quest to Learn is premised on the belief that digital games enhance intellectual exploration.

Game-Based Learning Sites

The following are examples of sites on which students can participate in game-based learning experiences:

- **Mathletics** - a math skill and drill site that allows students from around the world to compete against one another
- **Algebra Arcade** - a multiplayer online algebra and physics site that allows users from around the world to compete against one another
- **Mass Extinction** - learn about climate change and its effects on populations
- **Kinetic City** - science games for elementary and middle school
- **OceanQuest** - a game for exploring deep ocean ecosystems
- **Immune Attack** - navigate a nanobot through a 3D environment of blood vessels and connective tissue in an attempt to save an ailing patient.
- **Ghosts of a Chance** - allows students to decipher codes, read maps and discover hidden treasures in a multimedia scavenger hunt
- **Global Conflicts** - this game teaches concepts in citizenship, geography and media. It includes lesson plans and assignments
- **PeaceMaker** - learn about diplomacy and foreign relations in your role as Israeli Prime Minister or Palestinian President

Open Educational Resources

While online and blended learning models provide a way to rethink approaches to delivering curriculum, technology-enabled teaching and learning is also supported through the use of open educational resources. Open educational resources are teaching, learning, and research materials that are freely available to anyone via the Internet. Ranging from digital textbooks and libraries to podcasts and instructional games, these resources can serve as key elements in teaching and learning experiences. As with any new and/or unfamiliar educational materials, it is necessary to examine these resources to ensure that they meet standards of quality, accuracy, and integrity.[43] Accessibility and adaptability to various levels of learners and learner styles should also be considered.

For example, the Khan Academy[44] is a non-profit educational organization that offers thousands of free video tutorials, lessons and interactive exercises online across a range of topics. Khan Academy's YouTube channel[45] has been viewed more than 450 million times. Informal in style, the tutorials are designed to build knowledge one concept or lesson at a time. Students are able to maintain records of their progress and teachers can also monitor the progress of their students who participate on the site. Khan Academy democratizes education and levels the educational playing field across the globe.

CK-12[46], another non-profit organization, provides open-source content and technology tools to help teachers enrich the learning experiences they provide. Instructional content is customizable, and mapped to multiple learning styles and modalities. Teachers can even build their own textbooks with CK-12 resources, either from scratch or by using materials in the FlexBooks library. Teachers may also access Open Educational Resources (OER)[47], an open source model for material created by diverse content creators and providers that is offered free of charge, as well as have students install an application on their devices that provides free access to public library digital media content.

Mineola Union Free School District

In 2010, the Mineola Union Free School District's (UFSD) Board of Education was tasked with continuing the District's innovative approach to teaching and learning through the utilization of technology as they implemented new Common Core standards, new assessments, and a new Annual Professional Performance Review plan. Their vision was to create a differentiated, rigorous curriculum that simultaneously individualized instruction and engaged students in the joy of learning.

The Mineola UFSD Board of Education believed that by cultivating the right partnerships they could increase student achievement by targeting student deficit areas in a unique and fun way. In September 2014 they supplied over 1,600 mobile devices for every student in grades 3-9 as well as classroom centers in all K-2 classrooms, funded through Governor Cuomo's competitive education grants for management efficiency. Each device is outfitted with a variety of applications that include two specific programs where companies worked side by side with administrators and teachers in Mineola to create products that focus on personalizing content for each student. UFSD has been able to use benchmark assessment scores to target specific areas of need for each student and generate electronic portfolios of actual student work that can be assessed by standard. These programs complement each other by tracking student progress in assessments that align with standards as well as standardized exams.

Within the district, 25% of students are free and reduced price lunch recipients and there are a large number of students without Internet access at home. For these students, the District invested in devices with a 3G connection. Teachers log in to answer questions, join the conversation or monitor student engagement. UFSD has also used technology to extend the school day and lessen the traditional 'summer loss' that occurs during periods when students are out of the classroom. Through the use of social networks, students communicate and collaborate with classmates and teachers long after the bell rings.

Technology has transformed the way teachers think about teaching and learning. Problem (or project) based learning has become the norm in Mineola. They are currently digitizing their entire curriculum to allow for even greater use of the technology tools they have adopted. The school's investment in technology is paying off. Mineola's Middle School has recently been recognized as an Apple Distinguished School and the Mineola School District is also a proud member of the League of Innovative Schools.

VI. Part Three: Critical Infrastructure & Supports

A successful transition to connected learning requires schools to have sufficient physical and human infrastructure in place. To fully transition, schools need sufficient broadband access to their schools as well as wireless networking inside the building. In addition to these physical assets, schools must also provide the appropriate supports to their staff to ensure that the human infrastructure supports the transition to the digital classroom.

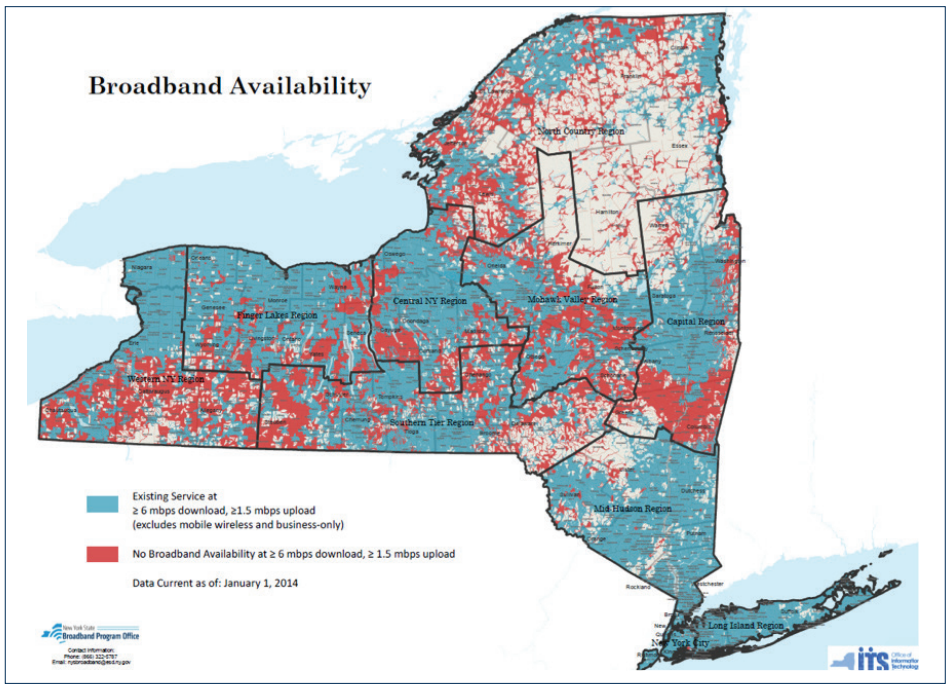
Internet Connectivity

New York defines broadband availability in the State as 6 megabits (Mbps) download and 1.5 Mbps upload, higher than the Federal Communication Commission's (FCC) definition of 4 Mbps download and 1 Mbps upload. There is widespread agreement that the FCC's speed definitions are quickly becoming obsolete, as new applications and services continue to evolve and demand higher requirements. For example, high definition video streaming requires 10 to 30 Mbps per stream. Other states and the FCC are in the process of redefining minimum speeds.

New York's broadband landscape has undergone a significant transformation over the past several years. Between 2008 and 2013, broadband availability in New York State rose from 54% to 95%, bolstered by more than $70 million spent on broadband projects during Governor Andrew M. Cuomo's administration. This State investment has opened doors to new economic, social and educational opportunities for New York's unserved and underserved communities.

Although New York is making steady gains in penetration, too many New Yorkers are unable to harness the transformative power of broadband because they lack access to broadband services or are otherwise unable to subscribe. Approximately 1 million people lack access to broadband services, while another 6.4 million New Yorkers are unable to subscribe to broadband.

The map below depicts where broadband is available in New York State and where it is not.



Source: New York State Broadband Program Office

Broadband Adoption

Broadband adoption refers to the rate of subscribership in areas where service is available. New York State's adoption rate is approximately 70%, which is slightly above the national average. Yet barriers to entry prevent many New Yorkers from subscribing to broadband service. When analyzing the adoption of broadband Internet services, and how it used, problems such as affordability, digital literacy, and perception of need continue to be the three most significant obstacles, especially for economically and socially disadvantaged New Yorkers.

For example, as identified in the New York State Broadband Adoption Report, only 37% of New Yorkers with annual incomes of $20,000 or below have broadband at home while New Yorkers with incomes over $60,000 have an 85% adoption rate.

Broadband Stimulates Economic Recovery and Job Growth

Broadband access helps New York keep pace in the national and global marketplace and remain vibrant. High-speed broadband networks can: accelerate robust economic development across our State; enable our communities to attract and retain business, expand small business markets, and create new jobs; and increase access to healthcare and to quality education.

Broadband Benefits for Education

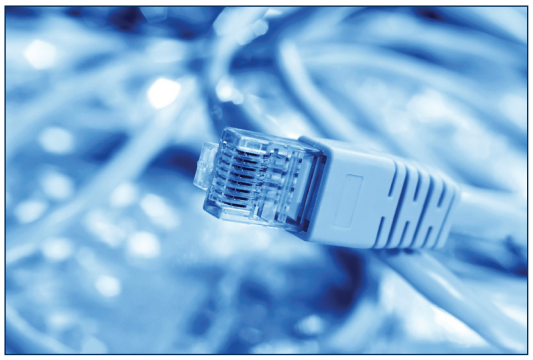
Broadband is a critical component of today's K-12 school learning environment. Schools require fast, reliable broadband infrastructure to keep pace with rising educational requirements and standards. More importantly, with advanced broadband capacity, educational opportunities become endless. Students can use online tools to take courses from anywhere around the globe. They can watch videos or view famous works of art; conduct online chats with teachers, counselors or students from around the world who may be studying the same information; and gain expanded access to instructional resources, e-books and library-based information.

With in-school and at-home broadband, teachers can expand instruction beyond the confines of the physical classroom and traditional school day. Broadband can also provide more customized learning opportunities for students to access high-quality, low-cost and personally relevant educational material. Broadband also improves the flow of educational information, allowing teachers, parents and organizations to make better decisions tied to each student's needs and abilities.

Use of Broadband in Education

- Expands Educators' Instructional Capabilities
- Boosts Students' Research And Interactive Opportunities
- Facilitates Communication Between Educators And Parents
- Promotes Engaged And Individualized Decision-making Based On Student Needs And Abilities
- Use Correlates to Higher Degrees of Education

Broadband Speed Requirements for Education



President Obama's ConnectED initiative aims for schools to gain access to broadband speeds of at least 100 Mbps along with a high-speed wireless network in every building.[48] This goal is in line with standards set forth by the New York State Board of Regents, State Educational Technology Directors Association, and leading education technology advocacy organizations. Speeds of at least 100 Mbps ensure access to enough bandwidth – the term to measure the rate of data consumption – to sustain school operations and ensure students have access to the tools and resources to be college and career ready.[49]

This level of connectivity is necessary to enable teachers to embrace digital learning and allow students access to web-based technologies such as online courses, video streaming, and remote learning.

While many technologies may be able to provide speeds of up to 100 Mbps, fiber optic is the only technology that can deploy consistent speeds of 100 Mbps to 1 gigabit or higher. Fiber is often regarded as the best broadband technology and experts prefer fiber technology over other broadband technologies. Fiber allows the download of mega-size files from the Internet to your computer at a very rapid pace. The cost of fiber is relatively lower than many other broadband technologies. In fact, EducationSuperHighway – a not-for-profit organization that works to ensure every K-12 public school in America has the Internet infrastructure that students and teachers need for digital learning – cites that districts using fiber networks have 75% lower cost per Mbps and nine times more bandwidth.[50]

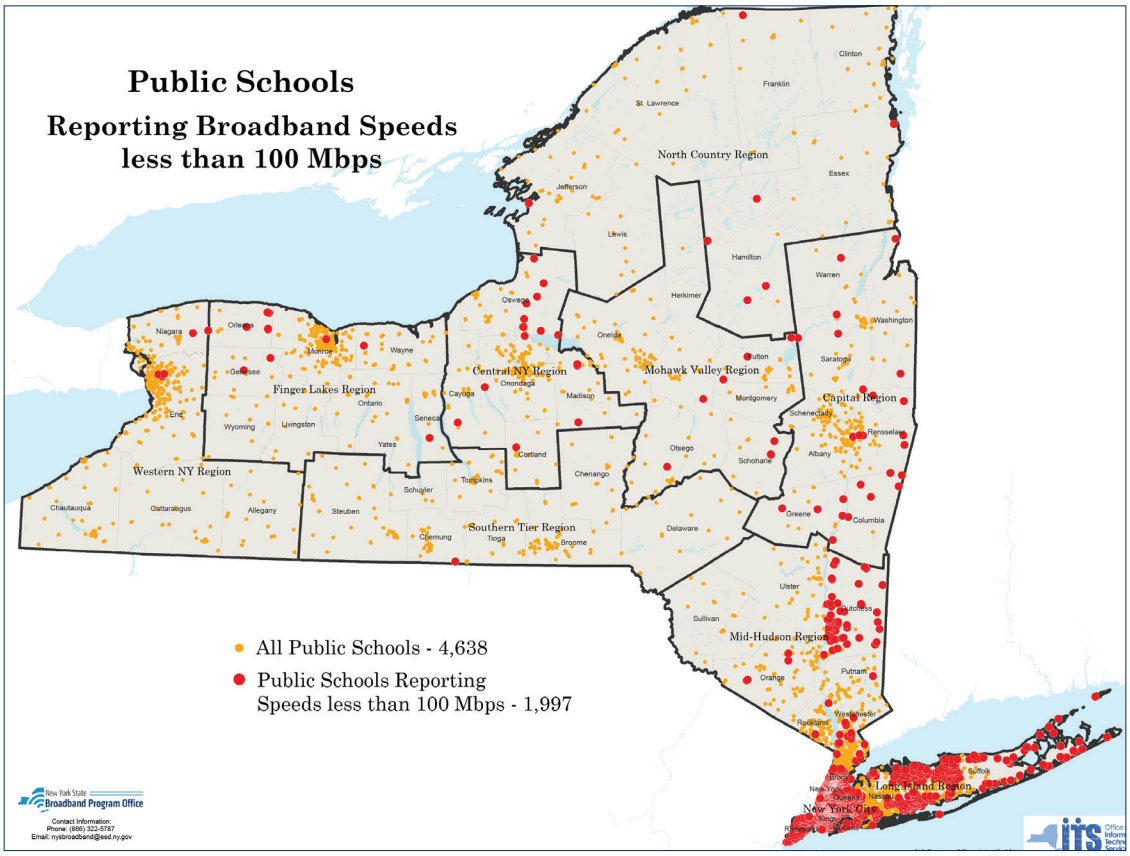
Key to Success # 3: Connect every school to high-speed broadband using technology that is capable of scaling up over time and deliver sufficient wireless capability to serve every student.

New York State is home to more than 2.7 million K-12 students among 4,775 schools and 693 school districts. While the President has set 100 Mbps as a minimum speed for schools, as of today only half of the schools in New York report speeds at or above 100 Mbps.

Further, more than 56% of New York Schools have inadequate broadband capacity at New York's lower broadband definition of 6 Mbps. Shockingly, 516 schools report no broadband service at all at New York's minimum speeds.

- 516 schools report no broadband service (speeds below minimum New York broadband speeds)
- 1657 schools report broadband download speeds less than 25 Mbps
- 2248 schools report broadband download speeds less than 50 Mbps
- 2390 schools have inadequate broadband service (as defined by Board of Regents and President Obama, <100 Mbps)[51]

The map below indicates Broadband Availability by School District and speed tier. As identified, the majority of very high-speed Internet access (>100 Mbps) is available in the NYC and Long Island regions, leaving the majority of the State with speeds of 50 Mbps or below.



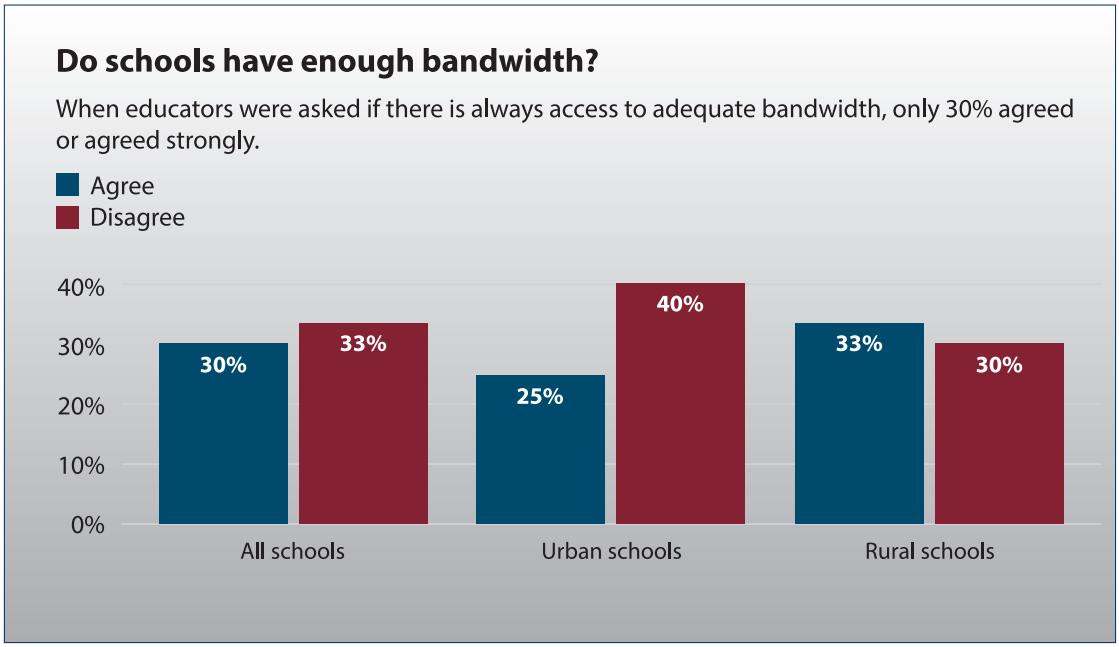
Source: New York State Broadband Program Office

To support the growth of digital learning and the successful integration of technology into teaching and learning, school districts must ensure that their schools have sufficient speeds both to and within their buildings.

Determining School Connectivity Needs and Costs

According to education leaders, the two major issues surrounding connectivity in schools are access to sufficient bandwidth/access to fiber and affordability. Access to sufficient bandwidth is a prerequisite for schools who want to use technology in creative ways since cutting-edge software and hardware place high demands on outdated networks. EducationSuperHighway cites that the demand for bandwidth is growing 30-50% per year in districts using digital learning.[52]

A study released by the Center for American Progress indicated that 70% of educators nationwide reported that their schools lacked adequate bandwidth, with urban schools reporting the access to least bandwidth as indicated in the chart below.[53]



Source: Software & Information Industry Association, "SIIA 2013 Vision K-20 Survey" (2013).

The second issue, affordability, is less apparent in affluent schools than low-income schools. Additionally, the rates schools pay for network connectivity and Internet access varies from school district to school district across the county.

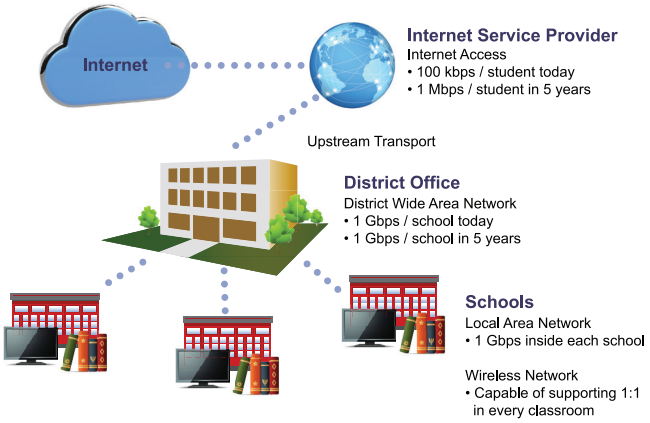
As New York school districts begin to think about connectivity, they should consider this roadmap:

1. Determine existing capacity and speeds currently being delivered to each school;
2. Assess the connectivity needs of the entire school district, while also accounting for the individual needs of each school building on a bandwidth-per-student basis;
3. Identify which schools require upgraded internal network infrastructure to support wireless networking and data storage needs;
4. Identify specific equipment required to support the upgrades in each school;

5. Aggregate demand for connectivity with other community broadband stakeholders such as Regional Economic Development Councils, libraries, higher education institutions, healthcare institutions, public safety stakeholders, and the business community. By aggregating demand among other broadband stakeholders, ongoing costs can be spread across a much wider base, minimizing costs while meeting critical community needs; and

6. Determine how to minimize costs by evaluating capital and operating costs for each option; maximize federal and private funding and explore regional cost sharing agreements with other school districts and stakeholders, where appropriate.

Sample School District Connectivity Schematic



Source: EducationSuperHighway; NYS Broadband Summit, June 2014.

Complementary Federal Funding

The FCC's E-Rate program provides funds to connect schools and libraries to high-speed broadband.[54] To date, the FCC's E-Rate program has helped connect many of New York's most remote schools and libraries.

The FCC is currently considering whether to modify the E-Rate program to support both the upgrade of connectivity to the school and the ability to distribute this connectivity into the classrooms. No matter the outcome, school districts must apply for and maximize E-Rate funds flowing to New York to help bridge the technological divide and complement State funding.

Community Connectivity Projects

The Smart Schools Bond Act allows funding to be used for community connectivity projects that expand high-speed broadband or wireless internet connectivity in the local community for "enhanced educational opportunity in the state."[55] As was previously discussed, students' connectivity needs do not end when they walk out of the school building at the end of the day, so districts may consider pursuing community projects that enhance students' connectivity outside of school as well, including projects that impact public libraries and students' broadband access at home

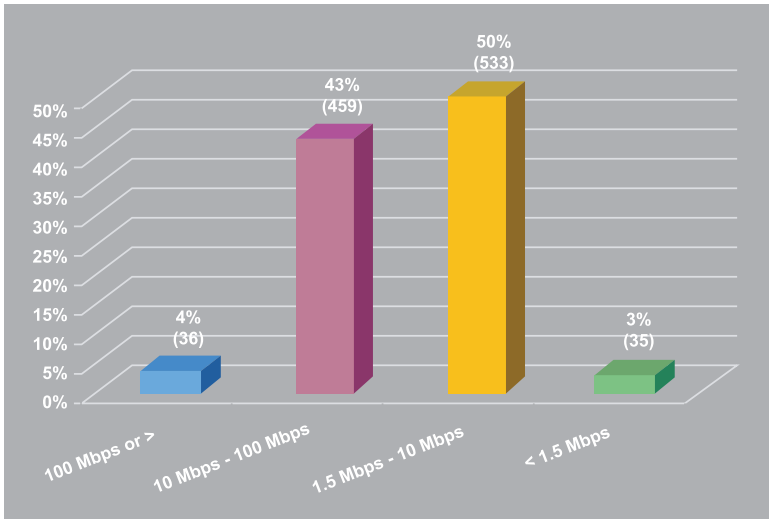
Key to Success # 4: Extend connectivity beyond the four walls of the classroom so students from all backgrounds have access to the information superhighway.

Broadband in New York State Libraries

In many instances, the public library is the only place outside of school where students have free access to the Internet to support their learning. However, New York State's libraries may require upgrades to support growing patron needs, especially in rural communities. With slow connections, libraries also have limited resources to offer services such as computer training or video conferencing.

As reported by the 2012-13 Digital Inclusion Survey,[56] average download speed in New York State libraries was 27.8 Mbps, compared to a national average of 57.4 Mbps. When asked, 69% of New York libraries indicated that they desired more bandwidth to support patrons' needs.

As indicated in the chart below, only 36 out of 1045 New York libraries report speeds of 100 Mbps or higher - *the speed necessary to support library operations and growing patron usage.*



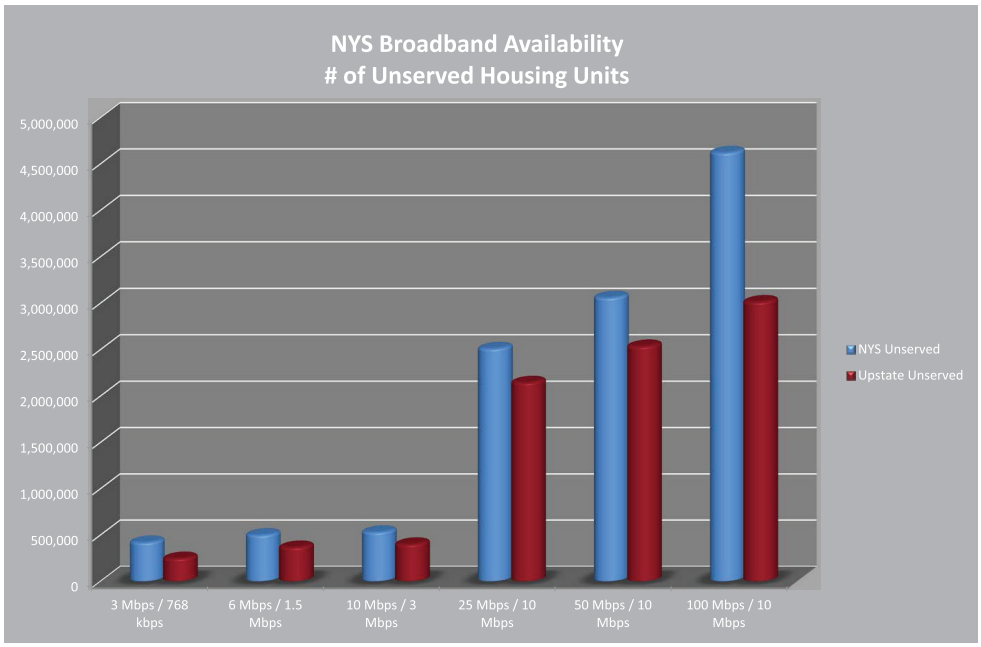
Source: 2013 Digital Inclusion Survey: Survey Findings and Results.

Education Extends Outside of the Classroom

An equally important component for achieving the best educational results for students is broadband access at home. While we are relying more and more on laptops and mobile devices to improve student learning, a seamless transition between use of broadband during school hours and after-school homework is important to the modern day student's success. Broadband access at home allows access to textbooks, parent portals, global information and experts, and enables students to complete assigned research projects and homework assignments with the benefit of internet resources.

Over 500,000 households lack access to basic broadband service that meets New York State minimum broadband speed standards. More than 4.6 million households in New York lack access to broadband speeds of 100 Mbps. Worst of all, five percent of all New York students lack even basic access to the Internet at home, leaving students in these households unable to complete even simple school-related online tasks at home.

The chart below indicates the total number of unserved housing units by speed tier:



Source: New York State Broadband Program Office

Home Broadband Affordability

Broadband permits a wide variety of online learning experiences. However, e-learning requires security, capacity, availability, world-wide connectivity, and equipment which may not be available in many of New York's educational communities. Even when services are available at school, many disadvantaged students lack these capabilities and resources at home. These communities need expanded bandwidth, more computer workstations, and affordable access to the Internet in order to be full participants in the global education arena.

Addressing broadband gaps not only requires robust broadband networks at the school and home, but also includes affordable broadband service and computer equipment. With more than 6 million New Yorkers not subscribing to Internet services, broadband affordability at home presents a major challenge. In New York State, approximately 30% of students, particularly those from low-income households, are still not connected to the Internet at home.

The obstacles of broadband availability and affordability encountered by students will likely worsen as schools become more and more technology dependent and look to provide students with Wi-Fi-enabled devices for homework assignments and to connect with other students and teachers. By improving access to reliable, robust and cost-effective broadband in school and at home, we can ensure that New York's students are prepared for digital learning.

Clifton Fine Students Get Connected at Home

Clifton Fine Central School District is located inside the Northwest corner of the Adirondack Park in Star Lake, NY. The school district and the local community have experienced a major transition over the past several years.

The school itself was connected to the Internet in 2008, but the community still lacked connectivity, with students' homes lacking access to DSL and cable internet. That was the case until Slic Network Solutions, a New York State Connect NY grant recipient, was able to connect the community to the Internet.

This expansion of connectivity to the community has dramatically changed the school and its relationship to the community. Instead of quarterly newsletters, frequent emails and electronic notices are sent via the school's website to the community. All grades, attendance, and homework assignments are now online. Bus notes are now completed via an online email submission. This has renewed the school's place as the center of the community.

This technological migration of the school to the web passed a new milestone on September 4, 2014 with the assignment of laptops to the 78 students in 9th through 12th grades. These laptops will be taken home nightly to complete homework assignments, access e-textbooks, and conduct research via the web. This milestone could not have been achieved without the connections to the students' homes. With an enrollment of 312, all students will utilize a technology device to access the Internet via broadband communication while in school.

Bringing broadband to unserved communities not only improves educational opportunities, but reinvigorates the school's role in the community, creating better educational outcomes.

Professional Development

In addition to the physical infrastructure required for the integration of technology in the classroom, schools also need to ensure that they have the necessary human capital infrastructure in place. Schools need administrators, teachers and staff skilled in how to leverage digital tools to transform teaching and learning. You cannot merely purchase technology and expect teachers to know how best to use it.[57]

The Commission heard from teachers who presented at public sessions and weighed in on social media that professional development is absolutely critical to any successful roll-out of education technology. This position is also supported by experts at the International Society for Technology in Education (ISTE), a national nonprofit organization dedicated to the concept of connected learning, which recommends that teachers engage in ongoing technology-related professional learning with dedicated time to practice and share ideas.[58]

> *To address the needs of our twenty-first century learners we need to prepare our teachers to develop the kinds of problem-based, project-based learning environments where technology is used as a thinking tool.*
>
> ~ Ellen B. Meier, Ed.D., Teachers College, Columbia University

Key to Success # 5: Provide high-quality, continuous professional development to teachers, principals, and staff to ensure successful integration of technology into the teaching and learning experience.

Effectiveness of Professional Development

There is no single definition for what constitutes effective professional development. However, a meta-analysis of studies of professional development programs prepared for the Institute of Education Sciences (IES) found that teachers who receive substantial professional development (49 hours, on average), can boost their students' achievement by approximately 21 percentage points.[59] The analysis showed that studies with teachers who received more than 14 hours of professional development showed a positive and significant effect on student achievement.[60]

What decidedly does not work are stand-alone, one-day workshops.[61] This is especially true when it comes to professional development related to education technology. Teachers and principals must learn how to implement new, technology-enabled instructional approaches and this requires ongoing professional development to achieve mastery.[62] Research also shows that teachers benefit from intensive coaching from master teachers as well as participation in professional learning communities.[63]

Pre-Service Professional Development

The U.S. Department of Education National Education Technology Plan recommends that districts "[p]rovide pre-service and in-service educators with professional learning experiences powered by technology to increase their digital literacy and enable them to create compelling assignments for students that improve learning, assessment, and instructional practices."[64]

There are teacher preparation programs across our public and private colleges and universities that are ahead of the curve and there are some that trail behind.

It is essential for colleges and universities that prepare and train teachers to add technology-enabled education into their curriculum to ensure that the teachers who graduate today are prepared to teach in the classrooms of tomorrow.

In-Service Professional Development: We Can't "Digitize the Status Quo"

If school districts truly want to shift instruction to incorporate and leverage technology, they must deliver high-quality technology-centered professional development. This professional development must address and incorporate the unique needs of each educational environment, including long-held beliefs of veteran educators who may not rush to embrace digital tools. Districts must also engage and educate school administrators and supervisors about the importance of technology use and the ways that they can support classroom staff in its implementation.

Long-time educators were not necessarily taught how to use technology to teach students. As we shift to a more digital future, it becomes critical that teachers are trained on how to use technology tools to engage students, prepare them for their digital future, and help them meet rigorous instructional standards. The Center for Technology & School Change at Teachers College, Columbia University's model for Professional Development encourages districts to provide interactive, hands-on professional development that is specific to the learning needs of their particular school and situation.[65]

The training must extend beyond technical assistance with the basics of technology to address technology and pedagogy as one concept. It must help teachers learn how to guide students as opposed to direct them and develop activities and lessons that seamlessly integrate technology into the existing curriculum.[66] Otherwise, districts run the risk of, as Ellen B. Meier, Ed.D stated at the July 17, 2014 Smart Schools Commission meeting, merely "digitiz(ing) the status quo."[67]

Professional development can be delivered by external providers or by in-house technology experts. Externally, many school districts contract with hardware and software vendors for the delivery of professional development in conjunction with an educational technology purchase. Vendors have a vested interest in ensuring that educators learn how best to leverage their product but the professional development can vary widely in cost, quality, and scale.

In-building professional development can be delivered via a combination of in-building or regionalized information technology experts[68] and in-building technology integration specialists or master teachers who provide instructional coaching and mentoring.[69]

No matter the type of professional development, the key is for districts to provide continuous, substantive support to their educators, technology staff and administrators. When determining what this is and how it looks, districts should consider the list of questions set forth by the Center for Public Education:

Questions for School Districts to Consider

Some additional questions for schools, districts and board members to consider when thinking about professional development:

- What existing professional development does the district provide?
- Does the district's current professional development programming align with research about teacher learning?
- Is professional development producing an impact on student learning?
- How is spending for professional development tracked by the district?
- Does the district need to develop more effective accounting codes to pinpoint professional development spending?
- Exactly how much is the district spending on professional development?
- How much teacher time is paid for within the current contract that is not used for individual teacher planning or classroom teaching?
- Which model for purchasing teacher time is most cost efficient for the district?
- What current in-house staff can be used to provide coaching and professional learning communities?
- What external resources can be used to staff coaching and professional learning communities?
- Is an in-house or consulting model of staffing more cost efficient and effective for the goals of the professional development, or is it better to have a combination of the two?

Source: http://www.centerforpubliceducation.org/teachingtheteachers

VII. Part Four: Preparing Students For the Jobs of Tomorrow

The impact and effect of technology on daily life are impossible to escape in today's world. Technology has changed the way we live and work and, as described above, presents a tremendous opportunity to revolutionize the way our teachers teach and our students learn.

Significantly, technology can help us to enhance learning and enable our students to attain the skills they need to succeed in today and tomorrow's post-industrial economy. We know that technology is here to stay – now we must determine how best to leverage the opportunities at hand.

In order to provide students with the best possible education, we must ensure that we are providing them with the skills required to succeed in the 21st century workplace. These skills include basic technology skills that have become a fact of life in today's workplace as well as those required for positions in Science, Technology, Engineering and Math (STEM) fields.

Key to Success # 6: Focus on in-demand STEM skills to ensure that students graduate with 21st century skills.

Mastering the Fundamentals

The global economy continues to shift toward one that is skills-based – one that requires high-level communication skills, technological aptitude, and problem-solving abilities. The effective deployment of technology in K-12 schools can help to ensure that students graduating from high school are proficient in these three areas and prepared to enter the workforce of tomorrow.

There are few fields today that do not require employees to possess a basic understanding and application of some type of technology, whether that is a smartphone, computer, or high-tech piece of manufacturing equipment. At its most basic, deployment of the appropriate technology in the classroom can expose students to word processing, Internet-based research, and e-mail skills that will prepare them to enter the workforce.

Mastering 21st Century Skills

While the basics are important, students today need to graduate high school with more than just those skills. They will enter a high-speed, hyper-competitive world very different than that known by their parents and grandparents. The forces of globalization have sped up every part of our lives and changed the way that firms do business.

We have seen a shift toward a greater supply of jobs that require an educational background in science, technology, engineering, and mathematics (STEM) with demand for highly skilled workers in STEM fields currently outstripping supply. In New York, there is an increasing need for STEM jobs, despite other downturns in the market.

According to *Change the Age*, an organization that works with business and education sectors to promote STEM learning, there are 1.7 STEM jobs for every unemployed person, versus 3.6 unemployed people for every one non-STEM job.[70] The New York State Department of Labor estimates that by 2018 the need for qualified employees with highly developed skills in software engineering will outstrip demand for employees in other traditional high-tech

occupations in New York, such as computer programmers and support technicians.[71] STEM careers are growing 2.5 times faster than the non-STEM average in New York State, with those working in STEM careers earning almost twice the average for all workers in the State.[72] Due to the rigor of STEM fields of study at the postsecondary level, it is critical to expose students to these areas early in their educational career. It is an economic imperative that New York students have the supports to master the 21st century skills they need to succeed.

Over the past few years, the State has made significant investments in STEM education. In February of 2013, Governor Cuomo announced the innovative partnership between Tech Valley High School and the College of Nanoscale Science and Engineering/SUNY Institute of Technology to better prepare students for New York's growing nanotechnology industry and build a world-class nanotechnology workforce to support it. The Capitol Region high school is working with the college on coordinated educational, training, and outreach initiatives targeting the 21st century disciplines of nanoscale science and engineering. This fall, a new Tech Valley High School building in Albany opened to over 140 students enrolled for the fall 2014 semester, with the freshman class at capacity. In the Finger Lakes, officials broke ground in February 2013 on a new, state-of-the-art Integrated Science and Health Sciences Building at St. John Fisher College. This initiative will serve to educate more than 1,200 STEM and health sciences students at its completion in fall 2015.

The State has also taken important steps to improve STEM education across New York and connect New Yorkers to STEM jobs. The Empire State STEM Learning Network, with support from the State's Regional Economic Development Councils, has developed 10 hubs across the State to drive local STEM initiatives. Local networks of STEM leaders from higher education, K-12, business, government, and community organizations work together to leverage resources, create best practices, and support educational institutions in preparing students to compete for STEM careers. For example, in Long Island, a consortium of five visionary STEM projects have been launched through REDC funding to support educational institutions, increase engineering graduates, enhance medical education and train youth for high paying technology careers on Long Island. These initiatives dovetail with the State's P-TECH initiative and STEM Incentive Program previously discussed.

The Commission offers the experiences of the Watkins Glen Central School District in New York, a presenter at the July 21, 2014 symposium and the New York City Department of Education, a presenter at the September 29, 2014 symposium as examples:

Watkins Glen

Beginning with an online learning initiative in 2009, the Watkins Glen Central School District has been transitioning toward a 21st century learning environment that prepares students to enter the workforce of tomorrow.

Early on, the district launched its Mobile Learning Device Project (MLD), providing 400 mobile devices to students in grades 5, 7 and 9. Through an iterative process between students and staff, and evaluations of local and State assessment data, the district further developed the program to capture multiple benefits, shifting to devices with more robust capabilities that proved to be even more user-friendly for teachers and students. Through the use of software created at the District's local BOCES, students were able utilize the MLD to engage in meaningful interactions with teachers both in and outside of the classroom. Student web lockers, podcasts, blogs, and interactive assessment activities all became a part of the instructional process.

Building on programs like the MLD, most recently, Watkins Glen cut the ribbon on a new 21st century learning facility that boasts high-speed broadband and wireless Internet access, a 2800 square foot STEM classroom, and multiple computer labs. Their students are actively engaged in various STEM educational projects related to robotics design and manipulation, solar and wind energy, and engine design. The district has recently added technical capabilities to teach students Computer Numeric Controlled machining (CNC), 3-D printing, and welding. Notably, Watkins Glen is developing an Introduction to Engineering curriculum for incoming freshmen in 2015

Expanded Learning at Brooklyn International High School

Students at Brooklyn International High School (BIHS) come from 50 different countries and speak over 35 different languages. Teachers are tasked with finding that one opportunity to grab each student's interest. In a school so diverse this can be a challenge, forcing educators to be especially creative in giving students different ways to showcase what they know. This year, as part of their Digital Ready program, BIHS teachers were connected with teaching artists. They collaborated with these artists to create dynamic student-centered curriculum and projects. Among the many partnerships that came through the Digital Ready program was a collaboration with Beam Works. The Beam Works artists worked with students in classes, and group of 11 students worked in an after school program in the fall. These students then continued to work with Beam Works during their 10-week spring internship.

Partnership with digital ready has allowed students to embark on side projects through classes or after classes or external internships. Students are learning much more than teachers can provide on their own, developing unique skill sets and interacting with professionals in the fields they want to enter.

Kamal

Kamal is a student who came from a village in Bangladesh in 2011, speaking very little English. He says, "In my country I never saw a computer. The Beam Center, they have a coding class. They taught me how to write code…They hired me for their job making apps and I making my own website with code." One of his teachers, Jason Fleischauer reports, "Kamal's confidence is really soaring, I think he sees more opportunities that are available to him now." He adds, "… when you have students that feel like they have more autonomy, they have more confidence and feel they have a skill set that is really unique, it filters down to all aspects of their life."

New York State is transforming the way it grows the economy and is giving students the education to succeed beyond the classroom. The State must continue to build on its efforts through broader introduction of learning technology into the classroom, which will expand student access to the tools they need to build a solid foundation in STEM fields. However, it is critical that investments be "undertaken thoughtfully," tailored to the unique needs of each school district.[73] Technology has the potential to greatly increase student performance and engagement in STEM fields; however, districts must make spending choices based on greatest impact for local students.

The success of the Watkins Glen School District and the New York City Department of Education shows how strategic investment in technology can transform dated classrooms and curriculum into STEM-focused, 21st century learning environments.

VIII. Part Five: The Importance of Planning and Process

While the most important result of school technology upgrades will certainly be the improved outcomes in student engagement, achievement, and college and career readiness, the Commission believes that the most important input for the success of a technology initiative will not be what devices school districts purchase. Rather, ultimate success in this endeavor will rely on the comprehensiveness of the district's planning process, regardless of the type of technology that it ultimately selects.

Key to Success #7: Plan, plan, and plan again.

Just as the computer coding world uses the phrase, "garbage in, garbage out" to describe a non-working computer application, school districts must undertake a strong, successful planning process to ensure the best possible academic outcomes from an infusion of technology. This process must engage the appropriate stakeholders, generate buy-in, plan for contingencies and sustainability, and, perhaps most importantly, allow for adaptation in the face of failure or unintended consequences. Even the best-laid plans will run into hiccups along the way, and the most successful school districts will be the ones who are able to adjust their technology plans along the way.

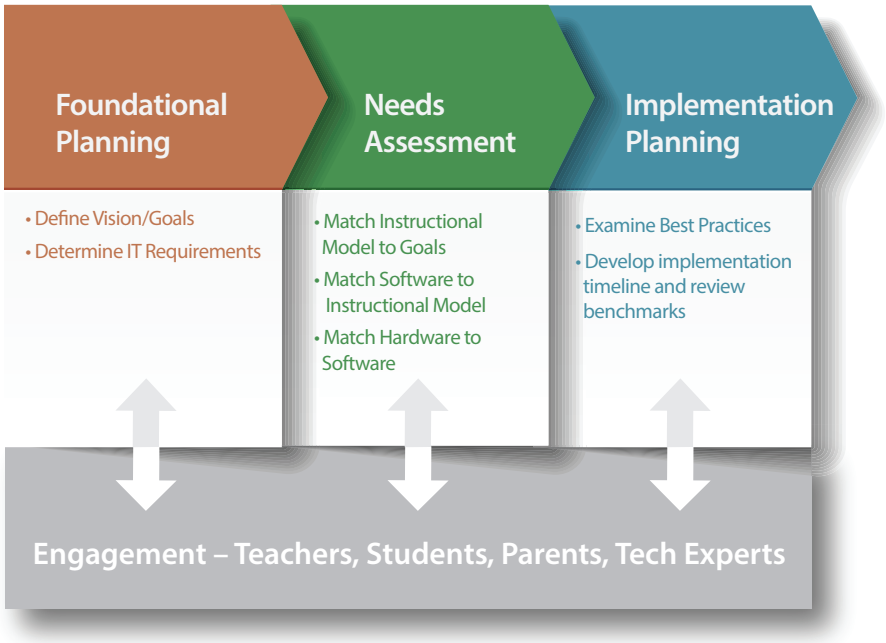
The Commission certainly was not the first entity to consider this important issue. In its research, the Commission came across multiple examples of suggested planning processes that ranged from the formal to the informal, from those commercially- to locally-developed, and from basic to far-ranging.[74] It was evident that each of these models had several key similarities, ones that boiled down to one simple formula, articulated succinctly by the technology integration team at the Riverdale Country School in New York City:

Vision + Buy-in + Plan + Professional Development = Successful Implementation

This simplified idea of how schools should approach integrating cutting edge technology into its educational program seems obvious and simple enough. But it requires a much more in-depth investigation: for instructional models, software, hardware, the strengths and weaknesses of the instructional staff, and the academic needs of the student population, among many other important components.

To create our recommended planning process, the Commission borrowed successful elements of district technology plans, best practices from State and national education stakeholders, and lessons learned from educators. The Commission used this information to sketch out a roadmap for school districts to use should voters enact the Smart Schools Bond Act.

This Commission does not seek to endorse any particular model nor push schools to use our summary model; instead we hope to help districts familiarize themselves with all of the elements and encourage them to adapt specific elements to suit their own local needs.



The above chart is a compilation of the common elements found throughout all the planning models we reviewed. They can be summarized in four main themes:

- **Engagement:** Bring together all potential stakeholders into all phases of the planning process to ensure positive feedback and "buy-in" from those that will ultimately be affected, and, hopefully, positively impacted by the plan.
- **Foundational Planning:** Define foundational goals and vision at the outset and assess current and future information technology needs. This effort helps districts avoid getting stuck with an unsuccessful strategy.
- **Needs Assessment:** Ensure that local educational vision and goals are aligned with the actual needs of the school, as well as matching the existing and desired technology.
- **Implementation Planning:** Synthesize all of the above elements and build in evaluation and feedback mechanisms to generate ultimate success.

Over and over, the Commission has heard these themes, both from success stories and from those schools that have experienced challenging technological integration attempts. It is the Commission's hope that a better understanding of the foundational process will help every school district achieve success.

Step One: Continuous Engagement

Active engagement of all the potential parties involved in a technology plan is the single most important ingredient to a successful program. Indeed, this should probably not be called "Step One," but rather "Steps One through Four." Its importance requires it to be woven throughout both the plan development process and throughout implementation and evaluation. Engagement is the process through which districts obtain buy-in from parents, teachers, and students. It is an ever-present component that requires constant care; changing your plan along the way without re-engaging those parties that you've already included can result in stakeholders not feeling the same commitment and support that they may have earlier in the process. Successful engagement requires consideration of the following factors:

Leadership

As with so many important projects today, success can begin and end with good leadership. In the world of education-technology integration, this can come in many forms—it could be a school superintendent who has a vision, a principal who has seen her teachers struggle with dovetailing outdated curriculum and instructional tools to fit fast-paced learning, or a teacher who wants more for their students. In any case, leadership that is born of passion is critical to the planning process.

A strong leader helps to drive the planning process. He or she can bring the initial necessary actors together to define collective vision and goals and outline steps to create and execute the plan. A leader can coordinate with teachers, parents, and students to ensure that the technology plan is evolving in a direction that meets the needs and strengths of its users. He or she can continue the feedback process to build a constant circle of support, allowing the plan to succeed where it can or fail in a way that allows for growth and recalibration. Leaders must be ever present and dogged in the pursuit of success.

Good leaders don't just corral the herd to work toward their vision; they also listen to feedback from others and incorporate it into the plan. Collaborative engagement is the key to creating the "buy-in" that will give school districts the greatest chance for success.

Schools may also choose to establish a leadership team rather than rely on the vision and time commitment of one individual. The Pennsylvania Classrooms for the Future program recommended this as a central component, with teams ensuring effective implementation of technology integration.

Breaking Down Silos

To effectively engage stakeholders, leaders must break down barriers to communication for all relevant parties throughout the planning process and beyond. Leaders need to break participants out of their silos and bring everyone together to provide input and make decisions. It is all too easy for stakeholders to become sheltered in their own networks and not talk to others, whether it is administrators and teachers, or teachers and technology staff, or any other number of combinations.

School districts across the State speak to the importance of breaking down silos. In the Innovation Zone schools in the Syracuse City School District, leaders engaged teachers to ensure they were comfortable with the technology that the school was choosing to integrate. In the Mineola School District, educators use apps that allow for collaboration and input among all teachers. The Washingtonville School District has brought in BOCES-based "tech coaches" that work with all teachers to better understand the technology and its application to education.

External Stakeholders

It is important for school districts to look outside of the ivory tower when developing and executing their technology plan and engaging external stakeholders.

One such important external stakeholder is the private sector. This includes not just the businesses that will provide the technology and related services to schools, but also the industries that will be hiring today's students as tomorrow's workforce. School leaders should communicate with local and regional industries about skills that will be necessary for their workforce in the coming years.

The K-12 education community should also engage with the postsecondary education community—community colleges, SUNY, CUNY, and private universities and colleges—to better understand what areas students most need to be prepared for when entering postsecondary study and how these can be addressed through technology. Potentially, these interactions may also lead to opportunities for sharing costs, materials, or training.

Step Two: Foundational Planning

Once a district has begun the initial engagement of stakeholders, school leaders must shift to creating the foundation for their technology plan. In setting the foundation, there are three main principles to follow: define your vision, set your goals, and determine your basic requirements.

Defining Your Vision

In order for New York schools to fully transition to Smart Schools, districts must reimagine the future of education, piece by piece. Superintendents, principals, and team leaders reading this report may already have an idea for what they want to do—interactive whiteboards, 1:1 tablets or laptops for students, or innovative engineering and manufacturing hardware. Whatever the case, these tools constitute only piece of the puzzle. Technology is only a tool; first, districts must determine what educational outcomes they seek to achieve for their students.

But what of those who may not already have a vision in their minds? This is a perfect opportunity to fall back on Step One and engage. There are undoubtedly stakeholders that see what the future may bring who will be eager to participate in the process.

A vision must be specific yet broad and flexible enough to adapt to changing circumstances throughout the course of planning and implementation. As the plan is developed, realities may present themselves that contradict an original vision. Too-little vision will complicate moving forward; too-specific vision may frustrate stakeholders and slow down the process.

"Think Spaces"

In the fall of 2013, Dr. Luvelle Brown, Superintendent of the Ithaca City School District (ICSD) worked closely with Dr. Derek Cabrera, a research scientist at Cabrera Research Lab, to develop the concept and design for 21st century learning spaces, including classrooms, meeting spaces, and other educational environments.

Of particular importance are the foundational principles that underlie the design of these unique learning spaces. These "ThinkSpaces" are based on research in the areas of the learning sciences, cognition, human ecology, and physiology. ICSD is changing several physical environments to support learning, change teaching practices, improve technology integration, and increase student engagement and achievement. Preliminary evidence from teacher and student interviews, along with observational data provided by both teachers and administrators, shows that these learning spaces are successful while contributing to the district vision of 6,000+ Thinkers through their mission to Engage, Educate, and Empower all members of the ICSD community.

The sleek "ThinkSpaces" utilize the interaction between the physical space and pedagogical principles to encourage metacognition and better thinking. This is in stark contrast to the traditional classrooms we see that are constructed based not on the learning sciences, but instead on architectural or design principles. ICSD's changes to learning spaces are based on simple principles of transformational pedagogy:

1. Learning is the first principle of physical design of space. The structure of this classroom is purposeful, based on learning science, and is designed to influence both teaching and learning behaviors.

2. Students learn by building knowledge, not just by recalling information. All desktops and walls are writable with dry erase markers. Multiple technology tools, including interactive whiteboards, mobile devices, web cams, and manipulatives, are available and their use is encouraged to facilitate the literal and metaphoric building of knowledge. Student thinking and work is therefore evident throughout the room's physical structure.

3. Physical movement stimulates neurons and our ability to focus. The furniture (such as buoy chairs, modular tables, wheeled cabinets) encourages movement, and engages core muscles, without distracting from the learning. Time spent sitting is limited. Students do much of their learning on their feet working in small groups around tables and at the walls.

4. It's not the teacher's room, it's a learning space for everyone. There is no front to the classroom. The teacher is a creator/designer of student centered learning experiences and does not "know in front of students" through lecturing but guides the construction of ideas. The space facilitates student construction of ideas.

5. We learn through reflection and feedback. One way mirrored glass allows for peer observation and feedback on teaching and learning by teachers and students. It allows for a set of home based best practices to emerge and be shared throughout the district.

6. Learning drives Technology. The spaces themselves make great use of technology, but unlike many modern educational spaces, the technology does not drive learning. Instead, technology supports learning.

Continued on the next page

This initial re-design of learning spaces for preK-12 teachers from throughout the district required $50,000 in capital improvements. Additional efforts throughout the summer and academic year have supported the adoption of these principles in several spaces across the District. In addition, several days are designated throughout the year for ICSD teachers to work intensively within the Thinkspace to better understand the science behind the space and pedagogical practices that highly engage students in the learning process. As a result, many teachers have also implemented changes to the physical space of their own classrooms using existing resources. This innovative, integrated knowledge building experience has re-engaged teachers with the art and science of pedagogy as well as the critical connection to the use of physical space to fully empower students in their learning processes.

Interview and observational data showed that all students were more engaged in these transformed spaces, without the necessity of extensive differentiation. In addition, the instructional practices and physical environment provided universal access to the simple process of building knowledge while working through the common core standards in every topic. An unanticipated outcome of this project was a dramatic decrease in student disruptive behavior, virtually eliminating the need for behavioral intervention. The space has also garnered local and national recognition from newspapers and educational sources such as the Association for Supervision and Curriculum Development (ASCD).

Setting Your Goals

Throughout the multiple models reviewed by the Commission, one distinction is very clear: vision and goals are two different things. While vision helps you to see the path you wish to embark upon, goals allow you to measure progress and provide clues for the next steps to be taken. Goals can take nearly any form—large and ambitious, or limited and measured—and guide you in multiple directions; from the types of educational devices you want to the student outcomes you want them to produce.

Our discussions with school districts suggest that the most successful plans are the ones that have goals focused on student outcomes, rather than a certain type of technology. These goals may include:

- Improving select test scores by a certain amount, either in the entire student population or a particular demographic;
- Having students prepare a particular interdisciplinary project, either individually or collaboratively;
- Leveling the playing field by ensuring all students have a specified minimum access to the internet and digital learning tools; or
- Expanding the availability of academic programs, such as distance learning, virtual Advanced Placement, or online blended learning applications.

As Dale Breault from the Northeastern Regional Information Center of the Capital Region BOCES put it during the July 21, 2014 Commission meeting, "decide first what you want out of an investment—'things & stuff' should not be the focus."

As districts develop their goals they must keep in mind the types of benchmarks that they will be able to measure over time. If districts find that the outcomes they seek are not easily measurable, they may have to refine their plan. Putting early thought into those measures will also serve districts well as they select instructional models, software, and hardware, providing a clear and direct connection between the technology and the desired outcomes.

As districts begin to set goals they may also want to begin to think about opportunities for piloting or phasing-in their plan. There may be complications when it comes to scaling up across the K-12 population and districts may choose to phase in technology over a period of time. This staggered approach may include particular student populations or age groups, with plans to continue to provide the technology to them as they move through grades while expanding technology to others.

Determining Your Basic Requirements

Once districts have goals in place—ones that have been arrived at through collaborative engagement and vetted for their measurability—they must also think about their current technology capabilities and what infrastructure may be necessary before moving forward. Having a 1:1 tablet program in a school may present exciting opportunities for students, but if a school is not equipped with sufficient broadband connectivity and wireless Internet access, the effort will fail.[75]

In addition to basic questions of Internet connectivity and wiring versus wireless, this is also the point at which you should begin to consider your support models. This extends to both technical support as well as professional development for your instructional staff. Here are some examples of questions to keep in mind:

- Does the school currently retain staff that understands the technical capabilities and pitfalls of various devices? If not, do resources exist at a BOCES Regional Information Center or in the private sector that can provide assistance?
- What is the current level of digital expertise among the instructional staff? Does the district have sufficient technology-focused instructional mentoring and coaching in place to help staff make the transition?
- What other professional development does the district currently provide to staff that may fit in with this plan? What programs are offered that might be outdated or ineffective and replaced with technology-specific professional development? Are there available financial resources that can be redirected into new models of professional development?[76]

School leaders and teachers must engage with their technology staff, BOCES Regional Information Centers, and other outside groups to measure their current technological capabilities, where they need to be, and what steps are necessary to get there.

Step Three: Needs Assessment

The transition to the third step in the process is nearly seamless from the second. This is the point in the process where it becomes vitally important for districts to have a clear vision and goals established, a deep engagement with stakeholders, and a willingness to adapt the vision to the circumstances at hand.

The Importance of Models and Software Over Devices

Over and over again, the Commission heard from individuals about the right order in which to integrate technology. Too often, leaders can get caught up in the bells and whistles of a particular device, and move heaven and earth to shoehorn those tools into their curricula. But if the tools don't meet the needs of the goals, if the teachers aren't engaged in the development of those tools, and, even worse, if the teachers are not prepared to deploy them, the school may face a very expensive failure.

At this point in the process, it is pivotal for districts to consider their desired instructional models and software before even thinking about devices. This point cannot be stressed enough. A technology initiative can represent a major financial investment and districts are strongly urged to work deliberatively through a planning process to avoid jumping the gun to reach for a particular device before they are ready to implement.

Match Instructional Models to Goals

The first step of districts' needs assessments, while engaging with teachers, parents, students, and technology advisors, should be to consider what instructional models districts want teachers to implement. Because teachers will be the ones working with those models on a daily basis, their input and buy-in is absolutely vital.

There are numerous models[77] to choose from and many can be combined in a hybrid format with others. A popular model in many schools today is the "flipped classroom," where traditional class time is reversed. Rather than teachers lecturing in class and sending students home with homework, they instead record lecture videos for students to watch at home and use classroom time to work through assignments and projects, both on an

individual level or as a group. This also provides greater opportunities for differentiated lessons plans, allowing all students to learn with visual and audio cues and a pace that best suit them.

Not all teachers will utilize the same instructional models. Some may resist the shift toward technology altogether. It is, as always, important to keep the lines of communication open and continually engage teachers during roll-out. The district may ultimately choose to employ a single model or device, but consideration of teacher input along the way will smooth the transition.

Match Software to Instructional Models

Once a district has narrowed down its instructional model or models, it can now shift to considering specific technology. Districts should begin with software; programs and applications, regardless of the hardware through which they are delivered, will have the most impact on a district's chosen educational goals. Among the questions to consider when selecting software, districts should answer the following:

- Are these programs compatible with multiple types of devices and operating platforms?
- After the initial purchase cost, what other costs will we face down the road? Are future updates available as a part of the package or are additional licenses required?
- Will these applications integrate with current technology used in the school, or in schools, BOCES, and private entities that we may partner with?
- Will we be provided 100% access to publisher content?

These can be very difficult questions to answer. The Commission recommends that districts engage with members of the technology sector to gain their advice and expertise, consult education technology nonprofit organizations, and solicit input from teachers.

Match Hardware to Software

At this point, districts may finally consider what devices they want to purchase and how to integrate them into the classroom. These considerations go beyond the simple question of tablet versus laptop versus interactive whiteboard; they also include the feasibility of blending the technology with the school culture and environment. Do the devices present student security and safety issues that districts will need to address? Has the district planned for usage policies that maximize student learning while minimizing waste, damage, and theft? Will the district allow students take devices home or use them only while within the school building – and if they go home with students, do students have connectivity at home?

It is also possible that a district may choose to pursue a plan to have students "bring their own devices" (BYOD). In this case, districts must be sure to provide sufficient connectivity to and inside every school building. In this instance, districts can shift focus to connectivity, networking, and operability concerns related to multiple types of devices.

Finally, districts must carefully examine the costs of selected hardware. Develop a sustainability plan that will allow for future phase-in of and upgrades to technology that uses a rolling replacement schedule to keep costs flat in the future. One approach might scale up full participation over five years and in the sixth year, replace the devices that were purchased in the first year. Districts should engage with the tech sector, local business officials, and taxpayers about the roll-out strategy and financial plan that will best suit their needs.

Step Four: Implementation Planning

At this point in the process, a district has continually engaged stakeholders, established a vision, set measurable goals, measured and addressed technological and connectivity capacity, selected an instructional model or models, and identified software and hardware to purchase. The district is now ready to take the next, and final, planning steps.

Review Best Practices

No district is the first to grapple with the issues of choosing and building a technology-enabled classroom.

There are many who have already forged a path and there are lessons to be learned from them. Districts should reach out to neighboring school districts, work with their BOCES Regional Information Centers, research third parties and foundations like those referenced in this report, and solicit input and feedback from relevant private sector vendors. Districts must not hesitate to ask questions and challenge assumptions.

The Commission relied on the advice of many such stakeholders to compile this report. There is a wealth of knowledge across the State about the best, and worst, ways to incorporate technology into the classroom. Engagement, as always, will be of the biggest benefit in this effort.

Create Your Timeline

By this point in the process, a district likely has sketched out a timeline for implementation. Whether a decision has been made to phase-in technology or immediately provide universal access, the required steps for complete implementation are known. In formalizing a timeline, districts may want to incorporate some of the following concepts:

- Designate leaders and point-persons who will be responsible for various steps of the process.
- Establish realistic and firm deadlines for step completion, while allowing flexibility to accommodate unforeseen setbacks.
- Ensure that the timeline doesn't just end with the integration of technology, but includes steps down the road needed to improve and update the plan.

It is critical for districts to communicate loudly and clearly with the local community with respect to this aspect of the plan. This can be accomplished by holding public events outlining the timeline, or having a version available on the district's website. Community buy-in is just as important as it is among staff and students—districts must not let residents feel left out.

Develop a Feedback Process

Lastly, districts should take care to build in mechanisms to receive feedback and make adjustments throughout the implementation process. This discussion began with a focus on engagement, so it is only fitting that it end with it as well. A district should create formal procedures for collecting and integrating feedback that are tied into the same benchmarks and goals that guide the plan. No matter the feedback, districts must remember that technology integration is not an overnight endeavor; it is one that will last far beyond the moments when a check is written and technology is delivered.

Conclusion

The Commission was charged with advising the State and school districts on how best to invest the proposed $2 billion Smart Schools Bond Act to enhance teaching and learning through technology.

From the beginning, we have recognized that the subject of this report is a complicated and important one for administrators, educators, students and parents. Accordingly, our work has been focused on collecting and presenting best practices, lessons learned, and research to school districts considering an investment in technology and connectivity.

The Commission's seven Smart Schools Keys to Success for school districts are the result of its engagement with hundreds of education, technology and STEM stakeholders over the last seven months. We believe that these Keys will help districts successfully integrate technology into the classroom and students' educational experiences. We recognize that this transition may be difficult and hope that we have provided districts with a solid foundation upon which to start planning for and making these important decisions that will help to reimagine teaching and learning for the 21st century.

Appendix

Summary of the 2014 Smart Schools Bond Act

Governor Cuomo proposed the $2 billion Smart Schools Bond Act of 2014[78] (the "Act") in his State of the State address delivered in January 2014. The Act was authorized in the 2014-15 New York State Budget. The bond will be submitted for voter approval in November 2014.

If the bond is approved by a majority of the votes cast, the Act shall take effect immediately.

Eligible Uses

If approved, proceeds from the bond will be spent to "improve[e] learning and opportunity for public and nonpublic school students of the State by funding capital projects to":

1. acquire learning technology equipment or facilities including, but not limited to:
    - interactive whiteboards
    - computer servers
    - desktop, laptop and tablet computers;
2. install high-speed broadband or wireless internet connectivity for schools and communities;
3. construct, enhance and modernize educational facilities to accommodate pre-kindergarten programs and provide instructional space to replace transportable class-room units; and
4. install high-tech security features in school buildings and on school campuses."[79]

Allocations

Every school district will receive an allocation under this program. Allocations are based on each district's respective percentage of Statewide selected School Aid.[80] School district allocations are available at www.smartschoolsny.com.

In addition, if voters approve the bond act, the State will provide $5 million for similar projects at special act school districts, State-supported schools for the blind and deaf, and approved private special education schools

Smart Schools Investment Plans

A Smart Schools Review Board (the "Review Board") will be comprised of the Chancellor of the State University of New York, the State Director of the Budget, and the Commissioner of the State Education Department. The Review Board shall issue guidelines that will inform districts' Smart Schools Investment Plans.

These guidelines will set forth "required components and eligibility criteria" for investment plans and will outline a timeline for the submission of plans, procurement guidance, any limitations on expenditures related to assets' probable life, and the loan of classroom technology.[81]

The statute requires school districts to develop their investment plan in consultation with "parents, teachers, students, community members and other stakeholders."[82]

Upon submission of an investment plan, the Review Board will review such plan for compliance with all eligibility criteria and guidelines. The Review Board may approve or reject a plan or return it to the district for modification. No Smart Schools grant will be issued until the Review Board approves the district's plan.[83]

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