FROM ONLINE TESTING TO ONLINE LEARNING

Lessons from Virginia, Alexandria City Public Schools, and the Classroom
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As the end of each school year draws near, the majority of America’s public school students prepare for a common rite of passage: federally-required annual testing. Today, students are less likely to encounter paper-based tests, since most use computers or tablets to take their assessments online. As states turn to online testing to measure and track students’ annual academic progress, every district is working to make sure its schools meet a minimum bar for broadband—high-speed Internet service most often provided through a wired connection—in order to administer these tests.

State-mandated online assessment may just be the push that finally brings every public school online. But the pull for districts to connect all schools with high-speed Internet extends well beyond testing: it could and should lead to access to online learning for all students.

Broadband connects students to learning opportunities that were previously unreachable. New digital tools are not only providing more responsive assessments, but these tools are also helping educators personalize content and instruction for their students. Students in connected classrooms are able to access information previously locked away in library, museum, and city hall archives; create multimedia content using new digital tools; and learn from and collaborate with experts and peers across the country and around the world. With intentional adoption and use, new technologies can help to ensure that all students are able to receive the preparation they need to succeed in their future civic and economic lives.

Unfortunately, as school districts look to increase their online services for teachers and students, they are often confronted with limited federal and state financial support, aging broadband infrastructure that cannot support higher speeds, and insufficient guidance on planning for future use. Further, district leaders are often left on their own to navigate how best to leverage broadband investments to support teaching and learning. They need to evaluate and choose between an abundance of devices and tools that connect new technologies with academic content, consider how best to include teacher and student input, and respond to challenges that arise while implementing these new technologies in the classroom.

Our public schools will not be able to provide all students with equitable access to learning if state and national education leaders do not help districts address these challenges.

The Commonwealth of Virginia provides a clear illustration of the challenges districts face—as well as how federal and state education leaders can offer support. Virginia began building out high-speed Internet access across all schools to
enable online testing a full decade earlier than many states, rolling out new digital assessments at the high school level in 2004, and then slowly expanding to middle and elementary schools. The state push for online assessment—coupled with requirements for broadband and device access—ensured that all of its “divisions” (Virginia’s term for districts) were connected.

But as divisions like Alexandria City Public Schools (ACPS) learned, the step from online assessment to online learning is more of a leap. Over more than a decade working to leverage technology investments to support teaching and learning, ACPS navigated a rapidly changing landscape of devices and tools. Division leaders learned for themselves the value of including teacher and student voices in technology decision making. And ACPS has continued to look for ways to monitor and evaluate network performance to ensure these investments are working for teachers and students.

This case study takes an in-depth look at Virginia’s experience over more than two decades as it has grappled with the infrastructure, resources, and supports needed for online testing and learning. It explores how and why the commonwealth has prioritized infrastructure investment and upgrades, as well as the impact those decisions have had on teaching and learning. Virginia’s story sheds light on how advances are made—and the work that still needs to be done.

With intentional adoption and use, new technologies can help to ensure that all students are able to receive the preparation they need to succeed in their future civic and economic lives.
This case study came together to connect the dots between federal policy, state leadership, and district work to secure equitable broadband infrastructure for schools. In July of 2013, the Federal Communications Commission (FCC) began to modernize its Schools and Libraries Program, more commonly known as the E-rate program—it was created to subsidize the cost of telecommunications and information services for these institutions. New America’s Education Policy program and Open Technology Institute provided feedback for improvements. Our recommendations highlighted the need to upgrade networks to fiber-optic technology, or fiber—currently the only technology capable of providing robust connectivity that can scale up to meet future demand. The resulting regulations put forward by the FCC brought about much-needed reforms that have prioritized investment in fiber, expanded support for Wi-Fi in classrooms, and brought greater stability and certainty in funding.

New America also recommended that the FCC prioritize the collection and release of better E-rate data on pricing and broadband speed. While the FCC has lagged behind, the national nonprofit EducationSuperHighway has played an important role in collection and dissemination on this front, supplementing information from the Universal Service Administration Company (the non-profit corporation created by the FCC to administer the E-rate program) with data it has collected directly from states and districts. This information has enabled state and district leaders, lawmakers, researchers, and the public to better understand the condition of broadband capacity in schools.

For greater perspective on how increasing demand for broadband infrastructure is playing out in schools, in 2015 New America partnered with Virginia’s Alexandria City Public Schools to analyze its network performance, given the technology environment of the division, the connectivity in classrooms, and the instructional use of devices and online resources. As a part of this research, team members interviewed local technology leaders, conducted a division-wide teacher survey, and collected broadband speed data at the classroom level.

This partnership exposed how Virginia’s adoption of online testing influenced the adoption and use of new technologies in the classroom. The commonwealth’s experience foreshadows what awaits states across the country that are just now connecting schools to sufficient broadband service to support online testing. The lessons learned over the past two decades in Virginia should serve as an important roadmap for other states as they move forward with online testing—and most importantly, online learning.
Connecting Virginia’s Schools Through Online Testing

Over the past 20 years, all levels of government have made significant investments to upgrade the technological infrastructure of public schools, helping a large majority of districts reach a baseline for broadband service. Through the FCC’s E-rate program, the federal government has provided billions of dollars each year to states and districts to upgrade the broadband infrastructure of schools. Just over half of states—including Virginia—also set aside funding for building out broadband to districts, and many local governments finance this infrastructure through municipal bonds, grants, and other methods. (See box on Broadband Access in America’s Public Schools on page 6.)

In 1998, as the E-rate program first began funding broadband infrastructure, the Virginia Board of Education commissioned a study on the availability and usage of education technology in the state’s public schools. The study found that while investments in new technologies were evident within schools, availability was inequitably distributed between, as well as within, divisions. According to the study, at the time 60 percent of Virginia’s classrooms had at least one computer with Internet access. “Unfortunately,” the report went on to say, “that percentage ranges from zero in some school divisions to 100 percent in others, with suburban schools averaging 75 percent of classrooms wired while rural schools report 46 percent and urban schools 36 percent.”

Further, the study found that technology use was primarily focused on skill development as opposed to mastering key learning standards. “The state is emphasizing integrating technology throughout the curriculum,” said the report, “but it has established [standards] for technology that are separate from the academic content [standards] and is testing them separately.” The separate testing of academic content and technology skills was identified as a key reason that new technologies were not being more consistently used across the state. Survey participants called for a more integrated approach.

In 1998, Virginia’s rollout of its new academic standards—known as the Virginia Standards of Learning—and state assessments provided an opportunity to better leverage new technologies for learning. That same year, Virginia established a new Standards of Learning technology initiative, which authorized annual grants to school divisions to build the infrastructure necessary for online testing. High schools would be required to move to online testing by the spring of 2004, followed by middle and elementary schools. While its other member states were paying limited attention to the potential benefits, the Southern Regional Education...
Broadband Access in America’s Public Schools

As the 20th century was coming to a close, the United States was starting to grapple with how to ensure universal access to the new technologies that would come to dominate the beginning of the next one. The first commercially viable personal computers had been released in the 1980s, followed by the Internet in the 1990s. Nationally, policymakers were beginning to recognize the promise of these tools, and determined that policy should ensure universal service for not just telephones, but for Internet access as well.

In 1995, the National Telecommunications and Information Association (NTIA) released one of the first reports detailing the status of Internet and device access across the country. This report, *Falling Through the Net*, identified Internet “have nots” as predominantly located in rural and urban parts of the country. Those without access in rural areas were predominantly low-income Native American, Hispanic, and black households; in urban areas, low-income black families were least likely to have access. This mirrored access in schools. While well-resourced schools had rushed to expose their students to these new tools, use was limited in rural and urban schools serving large numbers of low-income students.

In 2012, the State Education Technology Directors Association (SETDA)—a membership organization representing state education agencies—released a report called *The Broadband Imperative*, which spotlighted the ballooning number of student devices in schools and the corresponding demand for greater broadband. To meet demand, SETDA laid out a short-term broadband goal for districts to meet by the 2014–15 school year, the year that the majority of states had committed to roll out new college- and career-ready online assessments. The goal for high-speed broadband was set at 100 mbps for every 1,000 students, or 100 kbps per student.

Further, because the demand for broadband continues to grow at a remarkable pace, SETDA established a higher long-term goal for the 2017–18 school year at 10 times that rate: 1,000 kbps, or 1 mbps, per student. Put another way, by spring 2018, schools should have at least 1 gigabit of broadband for every thousand students enrolled (see Figure 1). These targets had widespread buy-in across SETDA’s membership in the states, as well as support at the federal level. Jessica Rosenworcel, a former Federal Communications Commission (FCC) commissioner and advocate for student connectivity, cited these targets during the push to modernize the federal E-rate program beginning in 2013. These targets reached a larger audience yet with ConnectED, the Obama administration’s effort to harness connectivity in schools to improve student learning. Further, nonprofit organizations and other stakeholders focused on school connectivity began to measure district progress using these speed targets.

These speed targets have served a valuable role in focusing attention on connectivity in schools, and establishing shared goals for minimum service. According to a report by the nonprofit EducationSuperHighway, 88 percent of school districts have met the first national benchmark for high-speed Internet service as of 2016. In numbers, that 88 percent translates to 35 million students—as well as 2.4 million teachers—in over 70,000 schools nationwide. In part due to the move to online testing, the vast majority of schools today have been wired to connect students online.

Though research has shown that schools have made significant upgrades to their broadband infrastructure, many still have a long way to go. According to the same EducationSuperHighway report, only 15 percent of schools have met the long-term benchmark for high-speed Internet service. This higher target accounts for increases in demand that accompany more ubiquitous device access and use in schools. Further, 19,000 schools throughout the country have not obtained access to high-speed broadband at all.

The reality on the ground is that connectivity continues to be more robust in some schools than in others. Schools serving students from historically underserved populations are too often the ones that remain underconnected. In many places across the country, infrastructure is being built and maintained that may support online testing, but is not sufficient for online learning.
Board reported at the time, “Virginia is moving systematically to implement online testing.”

This statewide requirement for online assessment created a baseline for connectivity across all of Virginia’s public schools. The state technology initiative set clear goals about what this baseline looked like, which included ensuring that every school was equipped with an Internet-ready local area network and had high-speed broadband to support testing.

The initiative also highlighted several additional benefits that increased connectivity would have for schools: improved Internet access for teachers; a greater ability to share instructional resources; increased communication among colleagues; and opportunities to integrate technology into instruction. The state, however, did not set clear goals or benchmarks for recognizing these additional benefits in schools and classrooms.

Virginia’s prioritization of infrastructure has enabled its schools to keep pace with requirements for online assessment. By the spring of 2011, 2.2 million student tests were administered online across the state, accounting for the vast majority of the assessments students took that year. The state’s sustained infrastructure funding and measured rollout of online assessment have helped most of its divisions keep pace with the connectivity necessary to administer these tests. They have also prevented large-scale problems from occurring, unlike in many other states, which have recently hit roadblocks due to a wide array of technical and logistical challenges. More than a decade after the first state technology grants were disbursed, Virginia’s General Assembly moved to require all tests to be administered online by spring 2013.

But testing online does not guarantee that technology will be integrated throughout the curriculum, as Virginia has been calling for since the 1990s. While new technologies have been consistently adopted and used across the state for testing, their use for learning is uneven.

Over the past few years, the commonwealth has begun to recognize and address the challenges that stand in the way of divisions fully leveraging broadband investments for online learning. Bobby Keener, chief technology innovations officer for the Virginia Department of Education, is working with leaders across the state to articulate what online learning looks like. “It’s not just about putting the infrastructure in place,” Keener said in an interview with New America, “but it’s also giving divisions examples of how they can use it.”

Keener has pushed for prioritizing robust Internet connectivity to support online learning. He emphasized the critical role federal funding plays in helping divisions connect with existing broadband infrastructure. One of the ongoing challenges, however, is in planning for future use. “They’re not building for next week,” he told us; “they’re building for today and tomorrow.” Adopting new technologies without this requisite broadband infrastructure creates additional challenges for divisions.

“We don’t want to build a bridge to nowhere,” Keener said, reflecting on Virginia’s two decades of investment in infrastructure for its public schools. It is up to Virginia, he said, to provide rich examples of how the Internet can be a bridge to learning for students.
As Virginia’s technology grants were first being administered in 1998, Alexandria’s public schools were already coming online. With the state’s timeline to roll out online testing in high schools by 2004, the spotlight in Alexandria was focused on T.C. Williams High School. All high school students in Alexandria attend the same school, split into two campuses—one for all the division’s ninth graders, and a larger complex for students in tenth through twelfth grades.

While the state push for online testing required Alexandria to meet a baseline for broadband, the pull for the division to provide students with opportunities for online learning led ACPS leaders to try something new. Instead of providing only one device for every five students as the state required, the division instead rolled out one of the state’s first one-to-one initiatives: every high school student would have access to his or her own personal computer, able to tap into the wealth of resources available online.

Online assessments for the year proceeded as planned, but the one-to-one initiative faced numerous challenges from the start. While the state technology initiative provided clear direction and goals for online testing, there was much less guidance and support for fostering online learning.

At the time, Alexandria was left largely to its own devices to determine how best to leverage its technology and infrastructure investments to support teaching and learning.

Setting out to address these challenges, in 2005 ACPS promoted Elizabeth Hoover to better coordinate the division’s use of instructional technology. Hoover had started at ACPS ten years prior as a classroom teacher in Alexandria’s Cora Kelly School for Math, Science, and Technology. While completing her PhD in instructional technology, she transitioned to the role of instructional technology resource teacher, helping teachers better use technology in their instruction.

As the new director of instructional technology, one of Hoover’s key responsibilities was helping to reboot T.C. Williams’ one-to-one initiative. As she described in an interview with New America, up until that point the initiative had been led by the technology department, with little input from those leading instruction. With an interdisciplinary background that bridged both domains, she sought to better integrate technology decisions and instructional needs. Hoover said that integrating technology into instruction was not as simple as building infrastructure and providing devices, or requiring students to test online.
**Figure 2 | Alexandria City Public Schools**

### 12:1 student-to-teacher ratio

(14,216 students and 1,185 teachers at 21 schools)

### 1 Gb per second lit fiber connection

*2 gbps lit fiber connection in SY 2016-17, option for 10 gbps in SY 2017-18 (if needed)*

### 59% free and reduced-price lunch

Teachers needed access to instructional tools and training in order to fully tap into the benefits of new technologies in the classroom.

One of Hoover’s first steps was to put into place a learning management system—software that provides a single platform for organizing course materials and assignments, communicating with students, and managing student information. The division purchased Blackboard, and rolled out an initial pilot of software for teachers. “We thought we would train 30 teachers total,” she said of the pilot program. But unlike popular portrayals of teachers resistant to change, Hoover described teachers that were eager to learn. “We put up a two-day workshop for Blackboard and it was immediately filled, with a wait list.” While ACPS had initially planned a modest rollout, she said that in the first year it ended up training 75 percent of teachers. She said, “they finally had some place to post assignments, there was a student log-in, there could be continuity across classes for kids.” In short, it was a solution for connecting technology to curriculum and instruction.

After moving into the role of chief technology officer for ACPS in 2008, Hoover made a second key change. She worked to restructure the technology department and add an instructional component. “In this department, I have about 54 staff members, and 18 have their teaching license—it’s so important that you have your instructional experts and your technologists together,” she told us. Over the years, the department has also worked to bring in teachers as decisions are being made regarding technology.

The division also reaches out to students: “When it comes to key decision-making,” Hoover said, “students play a role.”

Teachers have become more involved in decision making, and as a result they have grown considerably more invested in using new technologies to enhance their teaching. “Usage has gone up tremendously,” observed Hoover. As new technologies have become more integrated in the classroom, she said, instruction has become more dependent on reliable access to broadband and devices. And as teachers become more reliant on technology for instructional purposes, the perils of connectivity challenges grow more significant.

Alexandria—as well as other school divisions throughout the commonwealth—has been successful in implementing online testing in large part due to its state’s leadership and investment in infrastructure. Divisions have had less support, however, in leveraging these investments to support teaching and learning. ACPS learned through trial and error about the need for tools like learning management systems to connect technology with curriculum and instruction. Local leaders also realized the need for soliciting input from a range of stakeholders, including instructional leads, technologists, teachers, parents, and students. And today, as ACPS’s one-to-one initiative expands to its elementary and middle schools, the division is still in search of tools to monitor and evaluate network performance at the student level to support learning.
THE CHALLENGES OF 21ST CENTURY CLASSROOMS: TEACHER PERSPECTIVES FROM ACPS

To understand how these challenges affect what teachers do in the classroom, New America conducted a survey in 2016 of educators in all of Alexandria’s schools. The teacher survey data from Alexandria illustrate the enormous changes public schools have undergone in a relatively short amount of time. The data also underscore the importance of robust broadband connectivity in schools, and the negative impact under-provisioning can have on student learning.

In addition to notebooks and pencils, every high schooler at T.C. Williams carries a Chromebook with them from classroom to classroom, along with the requisite chargers, thumb drives, and other accessories. Middle schoolers, however, have had a spottier experience. According to New America’s 2016 survey, only 38 percent of teachers in the middle schools said they had a device for each student in their classroom. The other 62 percent of reported a wide range of access, from one device for every two students (1:2 ratio) to just one device for every five students (1:5 ratio). Many reported relying on computer carts that are shared across teams or grade levels, noting that the devices are not always available when teachers want to use them for instruction. (Starting in the 2016-2017 school year, ACPS middle school students all received their own devices.)

Device access across ACPS’s elementary schools varied the most. About one third of PreK–3 teachers reported having a device available for every student. Many of these teachers reported that they have one or a few desktop computers or other devices in the classroom, with shared laptop and iPad carts available to check out as they become available. In a handful of the 12 elementary schools, fourth and fifth graders also have their own Chromebooks in class. Nearly 75 percent of fourth and fifth grade teachers who completed the technology survey reported that each student had his or her own device. (All of the division’s fourth and fifth graders now have access to their own devices for the 2016-2017 school year.)

Perhaps because their students have consistent, daily access to devices, high school teachers and fourth and fifth grade teachers were most likely to report that students use their devices at least once every day. Middle school teachers were least likely to report students using devices daily.

How exactly are teachers having students use their devices in the classroom? Most teachers (80 percent)
responded that two of the most common uses for these tools are to add variety to daily instruction and to tailor learning experiences for each student. Nearly the same percentage indicated that these tools allow for more self-directed learning, with students using devices to view lessons online and practice independently. A little less than two-thirds of respondents also reported using devices to support student collaboration. Teachers noted a range of other uses, including formative assessment, checking for understanding, quizzes, and classroom tests. Others reported having students conduct research online, write and edit papers and essays, and extend learning into the home by assigning videos and tutorials for homework.

In responding to a more open-ended question about technology use in the classroom, teacher answers reflect their work to integrate technology with curriculum and instruction. English language arts teachers describe students practicing with sight words and new vocabulary, accessing books at their reading level during stations work, and creating multimedia projects like digital stories and online writing portfolios. Math teachers are using a wide range of student resources for math practice, assigning online lessons and tutorials, and identifying a range of online games that reinforce key concepts. Science teachers are integrating virtual lab tools in their classrooms and social studies and government teachers are curating online news resources for students.

New technologies are not just being integrated into core academic subjects. Special subjects teachers are leveraging devices and digital tools in their classrooms as well. Music teachers are playing recordings of musicians and instruments for reference, teaching students to use digital tuners and metronomes for practice, and arranging sheet music for different ability levels. Art teachers are having students photograph their final products to create digital portfolios of their artwork, while dance teachers are helping students record performances to identify areas for improvement. (See Looking Beyond Classroom Teachers on page 15.) Digital tools have been used to push the arts in many new directions, and teachers are helping students experiment with different methods and tools.

**What kinds of devices do students utilize in your classrooms?**

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<tr>
<th>Device</th>
<th>Percentage</th>
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<tr>
<td>Desktop computer</td>
<td>24%</td>
</tr>
<tr>
<td>Laptop</td>
<td>83%</td>
</tr>
<tr>
<td>Tablet</td>
<td>48%</td>
</tr>
<tr>
<td>Smart phones</td>
<td>20%</td>
</tr>
<tr>
<td>Interactive white board</td>
<td>51%</td>
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Providing adequate broadband for the incredible range of activities students and teachers are completing daily is not a light lift, and slow or unresponsive Internet can be an enormous challenge. Overall, 38 percent of teachers reported experiencing Internet issues at least once a week. For teachers in one-to-one classroom environments, 44 percent report experiencing Internet issues at least once a week, while an additional 15 percent report daily connectivity issues—so over half of teachers report experiencing connectivity challenges either weekly or daily.

Half of the teachers surveyed reported that connectivity issues impact how frequently they use technology in their classrooms.

Teachers have devised a number of strategies to deal with the connectivity challenges in their classrooms, many of which will sound familiar to those who have spent time in classrooms. While students are able to work offline on their devices, one teacher noted, “I have to have a backup plan for bad connectivity.” Similarly, another teacher reported, “I still integrate technology as much as I can, but I’m having to waste a lot of planning time creating backup plans for when the Internet slows or fails.” The same teacher said students lose instructional time due to connectivity challenges. Another teacher wrote, “If I create a lesson that is technology-heavy, and it turns out to be a logistical nightmare due to logging on issues or speed access, it makes me hesitant to try and implement future lessons using technology.”

As teachers move to implement cloud-based platforms and tools in the classroom, this challenge is magnified. Without a reliable connection, students are unable to access their documents, presentations, and other assignments saved and stored in the cloud. Many teachers reported having students save drafts of their assignments on their devices or thumb drives, but that can cause unnecessary complications and confusion over edits on various drafts.

Similar challenges arise for streaming services, with teachers reporting high rates of video buffering—
While using devices in the classroom, how often are students using the Internet [i.e. conducting online research, collaborating via Google docs, using web-enabled apps like Think Through Math, etc]?  

![Circle chart showing percentages of teacher responses]

- **32%** 1–2 times per week
- **21%** 3–4 times per week
- **22%** Every day
- **16%** Not applicable
- **9%** Not sure

**Base:** All respondents. N=330.  **Source:** New America survey of Alexandria City Public Schools teachers.

How often do you experience problems with the speed of Internet connectivity in your classroom?

![Circle chart showing percentages of teacher responses]

- **17%** At least once per day
- **40%** At least once per week
- **26%** At least once per month
- **11%** At least once per year
- **6%** Never

**Base:** All respondents. N=311.  **Source:** New America survey of Alexandria City Public Schools teachers.
Looking Beyond Classroom Teachers

Much of the attention on the use of new technologies in schools focuses on classroom teachers and core academic classes. There are many other adults in schools who work with children, however, like administrators and school counselors; teachers for music, art, and drama; reading, math, and other subject-area specialists and tutors working with small groups of students or one-on-one. New America’s 2016 survey was open to all adults who work with students in Alexandria’s schools, capturing the unique and often overlooked challenges that these professionals face.

Ensuring classrooms have sufficient Internet service is critical, but sometimes other spaces in schools can be overlooked. This includes specialized use classrooms, as one teacher reminded us when she said, “the signal to the music room is low.” Another teacher observed, “when school use of technology is high, the ability to connect to it is sketchy.” There are many other areas in schools where connectivity may be overlooked. This includes spaces repurposed for pull-out instruction—including storage rooms, closets, extra space in school basements, and mobile classroom buildings brought in because of overcrowding.

Instruction outside of traditional classrooms, however, can be just as dependent on access to broadband. As one reading specialist noted, “my program software must be accessible daily, all day. When the Internet is down, students are missing critical reading comprehension skills, diagnostic assessments that record strengths and weaknesses.” Often, specialists are an afterthought—especially in school environments where every student does not have his or her own device. “Students lose valuable online experience with literacy when the Internet is down,” the same reading specialist said. “This is time that can’t be recovered.”

Finally, there may be additional needs that these professionals have for making the most of broadband connectivity, which may differ from the needs of classroom instructors. “ELL students need much more visual and auditory support,” said one ELL teacher. Additional tools that would be helpful for language instruction, including speakers and headphones, are not always available, though. “We should not need to go buy our own speakers!”
While the last few years have brought many stories about big state and school district technology challenges and mistakes, the state of Virginia has stood out as a source of steady progress. Rather than viewing technology as an end unto itself (or focusing on technology as solely an elective or vocational topic), the use of new technologies was explicitly connected at the state level to a core requirement for measuring teaching and learning: annual statewide assessment of student learning. Requiring these infrastructure investments for the purpose of testing created a mandatory baseline of connectivity and device access in schools, putting the state of Virginia leaps and bounds ahead of the majority of other states.

Even Virginia, however, is recognizing the leap that must be made from administering online testing to integrating technology into daily classroom instruction. While measuring student learning via online testing is a worthwhile pursuit, students will miss out on the full benefits of these investments in infrastructure if state and national leaders do not ensure districts have the supports necessary for connecting new technologies to curriculum and instruction.

To take full advantage of the opportunities presented by new technologies, education leaders at the federal, state, and local levels need to work together to support online teaching and learning. Below are four recommendations for how to begin to do so:

### I. Invest in Sustainable Infrastructure

Federal, state, and local leaders must maintain infrastructure funding, prioritizing investment in robust, scalable broadband infrastructure with future use in mind.

- **Invest in infrastructure.** Broadband infrastructure is the foundation for equitable access to online learning opportunities—without it, it will be impossible to achieve any parity in the kinds of opportunities students have to learn. The federal government should continue to invest in broadband infrastructure by maintaining increased annual funding through the FCC’s E-rate program. Further, while every state is rapidly pursuing online assessment, right now just over half of states have dedicated funding for broadband infrastructure for schools. Going forward, every state should set aside funds to help its districts meet basic infrastructure requirements to administer online assessments. At the same time, states should not narrowly set connectivity targets for districts to only meet the needs of testing.
• **Prioritize fiber.** As schools invest in upgrading their broadband infrastructure, the smartest investment they can make is in fiber-optic technology—wired connections that transmit data over longer distances and at faster speeds—due to its capacity to meet future bandwidth demands. The E-rate program should maintain its commitment to funding fiber, including self-provisioning by districts.

While states have made significant progress to ensure all districts are connected via fiber, those districts and schools that remain disconnected have some of the most challenging circumstances. These schools are often rural, located far from other schools, and have limited choice among Internet Service Providers (ISPs). While in the short term it may prove easier to rely on inferior infrastructure, it is not a long-term solution for providing equitable learning opportunities for these students. States have a responsibility to help districts in need access equitable service. Meanwhile, districts facing limited choices should consider all of their options, including the possibility of connecting to municipal networks or self-provisioning.

• **Plan for future use.** According to rough estimates, broadband usage continues to increase 50 percent per year. District leaders in charge of infrastructure decisions should plan for a future in which demand continues to grow. EducationSuperHighway’s Planning Toolkit recommends that leaders plan for peak usage, not just average usage; keep all users in mind, including students, teachers, and others that need access to the network; and continue to monitor networks and make adjustments to levels of service as needed.

II. **Connect Technology to Curriculum and Instruction**

State and federal leaders must provide guidance and support to districts, helping them to make informed decisions about devices, tools, and resources for online teaching and learning.

• **Encourage greater planning for online learning.** As the adoption and implementation of new technologies take off in schools, state leaders should more actively encourage districts to plan for online learning, not just online assessment. While infrastructure and devices are clearly necessary, they are not sufficient to support teaching and learning in the classroom. Districts are in very different places in terms of technology adoption and use, but there are common considerations that they must all plan for around adopting learning management systems, finding rich sources of content to draw upon, and choosing the right tools to support instruction. States can help to set a vision for online learning and encourage districts to plan for the kinds of educational opportunities they intend to provide in their schools.

• **Provide professional learning opportunities.** State education leaders have a clear role to play in providing opportunities for professional learning to districts, schools, and classroom teachers. Many district and school leaders are making decisions about new technologies in a vacuum, without access to—or even knowledge of—existing research about the effectiveness of various tools and products. Further, teachers are often left to determine on their own how to implement new technologies in the classroom. As the field confronts a rapidly evolving marketplace, it is critical that states provide professional learning opportunities to help education leaders make informed choices about devices, tools, and resources.
III. Include all Relevant Stakeholders in Technology Decisions

Federal, state, and local education leaders must ensure all relevant stakeholders are included in technology decisions, made in coordination with other critical decisions around instruction, curriculum, and assessment.

- **Break down silos in priority-setting and procurement.** It is easy to set technology priorities and make purchases without fully considering how new tools will support what is happening in schools and classrooms. School districts are too often organized in ways that result in this kind of siloed decision-making. These silos often lead to ineffective adoption and use of new technologies. Ensuring that decisions are made in coordination with choices about instructional models, curriculum, and assessment, however, will enable these new technologies to have greater impact. State and national education leaders should also lead by example, striving to break down existing silos between education and technology decision-makers.

- **Solicit input from a wide range of stakeholders.** Education leaders at every level should actively work to make sure the vision and goals being set for online learning are being made by a diverse group of stakeholders. This should include educators, parents, and students, as well as local government, business leaders, and other members in the community. Without input from educators, as well as students and their families, new technologies will never be fully connected to teaching and learning. Further, including diverse community stakeholders from the beginning to solicit input, ask questions, and raise concerns can increase support and improve technology choices.

IV. Provide Tools to Monitor and Evaluate Network Performance

Federal and state education leaders must connect districts with tools and resources to monitor and evaluate network performance at the classroom level.

- **Evaluate network performance at the classroom level.** School districts must be able to evaluate network performance at the classroom level—in real time—to understand how connectivity is working for teachers and students, and make informed decisions about classroom connectivity. The performance of the network connection only provides one piece of the puzzle when trying to determine whether a network is functioning at the needed capacity. Even in well-resourced districts, however, supporting students and teachers with consistent network performance is a difficult task, particularly when schools are not able to measure their networks at every level. Some districts do receive information from vendors about total bandwidth to their wide area network, at the school level, and per Wi-Fi access point, but most do not have access to such granular data. Federal and state leaders need to work together to identify solutions to network measurement for school leaders.

There are substantial challenges standing between where schools are today and where they must be if students are to fully realize the benefits of online learning. Every state has made some progress toward connecting schools, and each is in a different place today. But each state can help its schools avoid some of the growing pains of digital adoption by learning from these lessons, and investing today to improve future learning.

We do not want to set up high-tech schools that can only do one thing: test.
Appendix A: District Technology Survey

Introduction and Consent Form

Survey Purpose: This survey is intended to facilitate better understanding of the technology environment and internet usage within Alexandria City Public Schools (ACPS) classrooms. The survey is comprised of nineteen questions, divided into five sections: technology environment; technology use; online resource selection; connectivity; and demographic information (optional).

The data collected will be compared to classroom internet performance data collected during spring of 2016 to better understand how classroom internet usage relates to overall network performance.

Length of Time Needed: Approximately 10 minutes

Participation: Participation in this evaluation is voluntary. You may discontinue participation at any time without penalty.

Confidentiality: The following survey questions do not ask for personally identifiable information.

1. I give consent for my survey responses to be used for research purposes, and for full or partial quotation for print and/or electronic publication.
   ○ Yes
   ○ No

Section I. Technology Environment

These questions are included to better understand the kinds of technologies students in different classrooms and grade levels have access to in your school district.

2. Within which grade-level span do you currently teach?
   ○ PreK-3
   ○ 4-5
   ○ 6-8
   ○ 9-12
   ○ More than one, or all
   ○ Other (please describe):

3. What subject areas do you currently teach?
   ○ English language arts
   ○ Mathematics
   ○ Social Studies
   ○ Science
   ○ More than one, or all
   ○ Other (please describe):
Section II. Technology Use

These questions are included to better understand how students are using technologies in the classroom.

7. For which of the following instructional purposes do you use digital tools? (check all that apply)
   □ Delivering instruction directly to students
   □ Diagnosing student learning needs
   □ Varying the delivery method of instruction
   □ Differentiating the learning experience to meet individual student needs
   □ Supporting student collaboration and providing interactive experiences
   □ Fostering independent practice of specific skills
   □ Other (please describe):

8. Please elaborate on how you use digital tools in your classroom instruction:

9. While using devices in the classroom, how often are students using the Internet (i.e. conducting online research, collaborating via Google docs, using web-enabled apps like Think Through Math, etc)?
   ○ 1-2 Times Per Week
   ○ 3-4 Times Per Week
   ○ Every Day
   ○ Not Applicable
   ○ Not Sure

10. Please describe the kinds of online tools students are using (i.e. blogging platforms, video creation, website creation, collaborative presentations):
Section III. Online Resource Selection

These questions are included to better understand how teachers are selecting online resources for students.

11. What do you look for or want when selecting digital tools or software for the classroom?
   - Alignment with VA Standards Of Learning
   - Engaging Content
   - Multilingual Support
   - Interactivity (such as games or apps that allow participation)
   - Interoperability (such as Single-Sign-On through Learning Management System)
   - Price
   - Fun
   - Educational Branding / Marketing
   - Other (please describe):

12. Where do you look to find new digital tools or software to use?
   - App stores
   - Educational blogs
   - Recommendations from other teachers
   - Recommendations from parents
   - School requirements
   - ISTE or similar organizations' newsletters
   - Other (please describe):

13. Do you have access to all the digital tools and software you want or need?
   - Yes
   - No (if no, please describe what additional resources would be of use):

Section IV. Connectivity

These questions are included to better understand Internet connectivity in classrooms, and how connectivity does or does not affect use of technology in the classroom.

14. How often do you experience problems with the speed of Internet connectivity in your classroom?
   - At least once per day
   - At least once per week
   - At least once per month
   - At least once per year
   - Never

15. Does the connectivity in your classroom impact how often you integrate technology into your lessons?
   - No
   - Yes (if yes, please describe the impact):

16. What challenges do you face when implementing digital tools or software in the classroom (select all that apply)?
   - Buffering during video streaming
   - Slow arrival of messages or communication
   - Difficulty collaborating on a shared online document
   - Software malfunctions
   - Interoperability issues (i.e. cannot log in through LMS)
   - Access to equipment
   - Classroom management
   - Other (please describe):
17. Are there other issues with respect to your use of technology in the classroom that have not been addressed here? (For example, that may pertain to your specific grade level as compared with other grade levels?)

Section V. Demographic Information

Several national teacher surveys have been conducted on teacher use of technology in the classroom. These optional demographic questions are included to ensure that these survey results can be compared to national findings.

18. What is your age?
   ○ 20-29
   ○ 30-39
   ○ 40-49
   ○ 50+
   ○ Prefer not to say

20. What is your gender?
   ○ Female
   ○ Male
   ○ Prefer not to say

19. How long have you been teaching?
   ○ 0-5 years
   ○ 6-10 years
   ○ 11-15 years
   ○ 16-20 years
   ○ 20+ years
   ○ Prefer not to say
Appendix B: Overview of Survey Findings

**Question 2** | Teacher Grade Level-Span  \( (n=361 \text{ respondents}) \)

<table>
<thead>
<tr>
<th>Grade Level-Span</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>PreK-3</td>
<td>27%</td>
</tr>
<tr>
<td>4-5</td>
<td>11%</td>
</tr>
<tr>
<td>6-8</td>
<td>32%</td>
</tr>
<tr>
<td>9-12</td>
<td>15%</td>
</tr>
<tr>
<td>More than one, or all</td>
<td>8%</td>
</tr>
<tr>
<td>Other</td>
<td>7%</td>
</tr>
</tbody>
</table>

**Question 3** | Teacher Subject Area  \( (n=361 \text{ respondents}) \)

<table>
<thead>
<tr>
<th>Subject Area</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>English language arts</td>
<td>13%</td>
</tr>
<tr>
<td>Mathematics</td>
<td>8%</td>
</tr>
<tr>
<td>Social studies</td>
<td>8%</td>
</tr>
<tr>
<td>Science</td>
<td>9%</td>
</tr>
<tr>
<td>More than one, or all</td>
<td>33%</td>
</tr>
<tr>
<td>Other</td>
<td>29%</td>
</tr>
</tbody>
</table>
Question 4 | Device Access in Classrooms  \(n=361\) respondents

- Desktop computer: 24%
- Laptop: 83%
- Tablet: 46%
- Smart phones: 20%
- Interactive white board: 51%

Question 5 | One-to-One Classrooms  \(n=361\) respondents

- Yes: 51%
- No: 49%
**Question 6 | Frequency of Student Device Use  \[n=361 \text{ respondents}\]**

- **31%** 1–2 times per week
- **25%** 3–4 times per week
- **29%** Every day
- **10%** Not applicable
- **5%** Not sure

**Question 7 | Instructional Uses of Digital Tools  \[n=330 \text{ respondents}\]**

- **Delivering instruction directly to students**: 76%
- **Diagnosing student learning needs**: 58%
- **Varying the delivery method of instruction**: 81%
- **Differentiating the learning experience to meet individual student needs**: 80%
- **Supporting student collaboration and providing interactive experiences**: 62%
- **Fostering independent practice of specific skills**: 78%
- **Other**: 8%
**Question 9** | Frequency of Student Internet Use  

- 32% 1–2 times per week
- 21% 3–4 times per week
- 22% Every day
- 16% Not applicable
- 9% Not sure

**Question 11** | Qualities when Selecting Digital Tools or Software

- Alignment with VA Standards of Learning: 69%
- Engaging Content: 92%
- Multilingual Support: 38%
- Interactivity (such as games or apps that allow participation): 80%
- Interoperability (such as Single-Sign-On through Learning Management System): 21%
- Price: 24%
- Fun: 48%
- Educational Branding / Marketing: 6%
- Other: 12%
**Question 12** | Where to Look For New Digital Tools or Software  \[n=316\ text{ respondents}\]

- App stores: 42%
- Educational blogs: 49%
- Recommendations from other teachers: 89%
- Recommendations from parents: 8%
- School requirements: 44%
- ISTE or similar organizations’ newsletters: 12%
- Other: 15%

**Question 13** | Access to All Desired or Needed Digital Tools and Software  \[n=361\ text{ respondents}\]

- Yes: 48%
- No: 52%
Question 14 | Experience with Connectivity Problems  \( n=311 \) respondents

- **17%** At least once per day
- **40%** At least once per week
- **26%** At least once per month
- **11%** At least once per year
- **6%** Never

Question 15 | Connectivity Problems Decrease Frequency of Technology Use  \( n=311 \) respondents

- **52%** No
- **48%** Yes
Question 16 | Challenges to Implementing Digital Tools or Software  
(n=296 respondents)

- Buffering during video streaming: 60%
- Slow arrival of messages or communication: 23%
- Difficulty collaborating on a shared online document: 15%
- Software malfunctions: 29%
- Interoperability issues (i.e. cannot log in through LMS): 13%
- Access to equipment: 43%
- Classroom management: 22%
- Other: 20%

Question 18 | Respondent Age  
(n=310 respondents)

- 20-29: 21%
- 30-39: 31%
- 40-49: 21%
- 50+: 20%
- Prefer not to say: 7%
Question 19 | Respondent Teaching Career Length  (n=310 respondents)

- 22% 0-5 years
- 21% 6-10 years
- 21% 11-15 years
- 15% 16-20 years
- 17% 20+ years
- 4% Prefer not to say

Question 20 | Respondent Gender  (n=311 respondents)

- 78% Female
- 15% Male
- 8% Prefer not to say
Notes


7 Ibid., 2.


10 Ibid.

11 This study was called for in the state’s technology plan in order to gauge Virginia’s progress and chart a course for future investment. See: Six-Year Educational Technology Plan for Virginia (Richmond: Virginia State Department of Education, Division of Technology, June 1996), http://files.eric.ed.gov/fulltext/ED398869.pdf.


13 Ibid., 4.

14 Ibid., 41.


18 Bobby Keener (Chief Technology Innovations Officer, Virginia Department of Education), phone interview with author, April 24, 2017.

19 Elizabeth Hoover (Chief Technology Officer, Alexandria City Public Schools, Virginia), interview with author, Alexandria, Virginia, March 14, 2016.


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