FUTUREBUILDERS FOUNDATION
MISSOURI SCHOOL BOARDS' ASSOCIATION

Missouri Wonk

POLICY BRIEF

DIGITAL READINESS FOR MISSOURI SCHOOLS

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Blended Learning and the Bandwidth Barrier

Just because drivers have access to vehicles and roadways doesn't always mean they get where they need to go. Congested streets or closed ramps can lead to detours and delays. Similar issues arise in the classroom when schools lack adequate bandwidth. Students with computers and Internet access often face roadblocks to learning when Internet usage needs exceed a school's broadband capacity.

In Missouri, close to 98 percent of K-12 public schools have computers and more than 94 percent have some access to the Internet. What those figures fail to show is how well our students, faculty, and staff connect to the Internet and whether or not they are getting where they need to go in this new digital world.

Not long ago, we focused on ensuring students and educators knew how to use computers to perform basic tasks or develop keyboard skills. However, technology has transformed the learning environment into a space where teachers blend individual instruction with a digital curriculum.

Many schools may have state-of-the-art equipment, but without a robust infrastructure to support digital learning, students get stuck on the side of the road. In fact, only 20 percent of schools in the Show-Me State have enough bandwidth capacity to take advantage of the personalized and rich digital instruction now available. Insufficient bandwidth results in slow connection speeds that bog down the online learning process and frustrate users.

Integrating technology helps teachers improve communications, expand curriculum, and reduce administrative burdens. Blended learning gives students more ways to absorb information. High quality digital content requires a robust infrastructure, yet only a fraction of Missouri schools fall into a category considered "technology rich" by today's standards. The chart on page two shows the digital capacity of Missouri schools.

The State Education Technology Directors Association (SETDA) expects the demand for bandwidth to increase ten-fold by the 2017-18 school year and recommends that school leaders recognize this trajectory and plan accordingly.

Bringing all schools up to speed will require a state and local partnership

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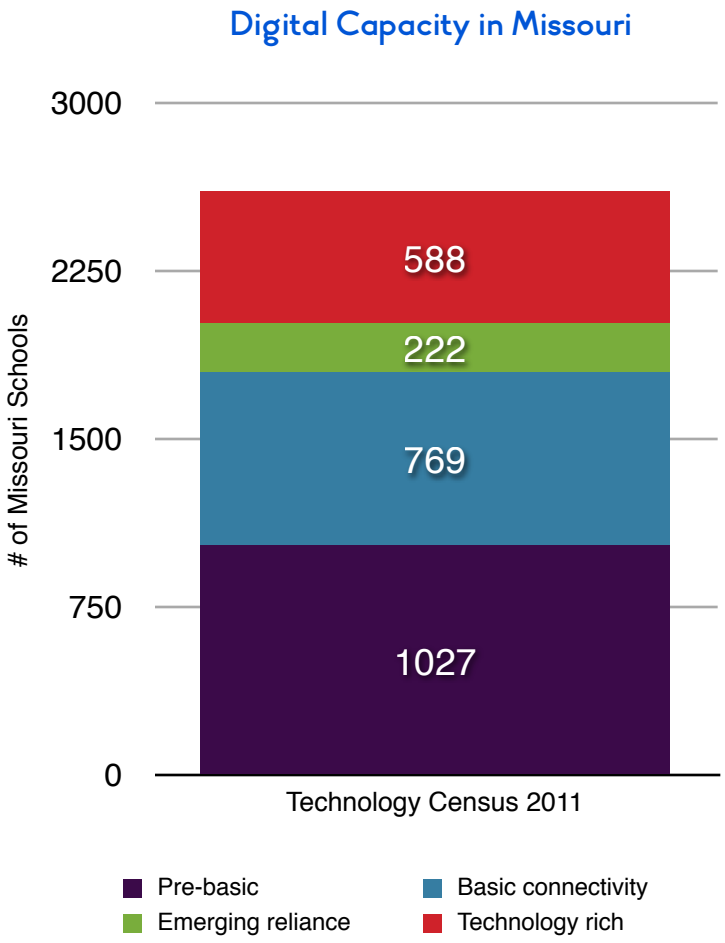
focused on investment and innovation in order to take advantage of the ever-evolving online offerings. Missouri school districts that achieve "digital readiness" will likely produce better outcomes in learning, communication, and innovation while preparing students for a globally connected world that expects a workforce with twenty-first century skills.

THE PROBLEM

The move towards a digital future occurred more than half a century ago with the invention of ENIAC (Electronical Numerical Integrator and Computer), the first electronic general use computer that combined both speed and power to perform a wide range of reprogrammable functions. ENIAC could calculate 5,000 addition operations per second through a $500,000 piece of hardware that filled a room and weighed 30,000 metric tons.

Today, that same amount of computing power easily fits on a chip of silicon not much bigger than a grain of sand. After ENIAC was presented to the public, the *New York Times* reported, "Leaders who saw the device in action for the first time heralded it as a tool with which to begin to rebuild scientific affairs on new foundations."

Dr. Roger Caldwell, the former director of Educational Communications and Technologies at the University of Arizona, points to a quote by Alvin Toffler, "The illiterate of the 21st century will not be those



Understanding Bits & Bytes

1 Byte = 8 bits

Units of bytes measure file size.

1 KB (one KiloByte) = 1,024 Bytes
1 MB (one MegaByte) = 1,024 KB
1 GB (one GigaByte) = 1,024 MB

Units of bits measure data transfer speed.

1 Kbps = 1,000 bits per second
1 Mbps = 1,000,000 bits per second
1 Gbps = 1,000,000,000 bits per second

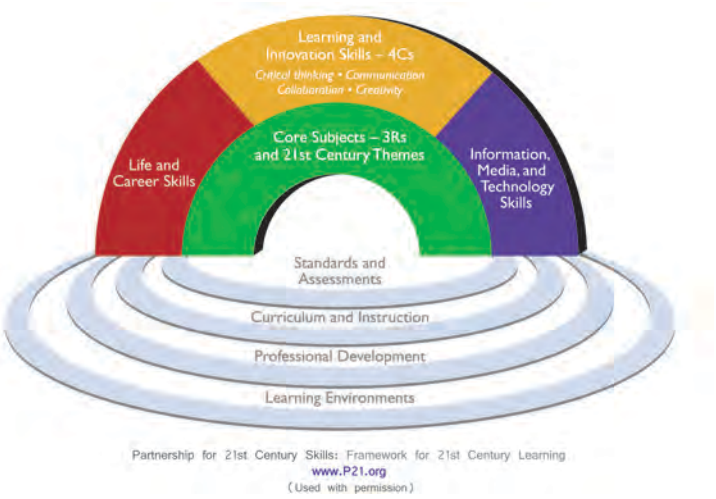
who cannot read and write, but those who cannot learn, unlearn, and relearn." Learning and teaching methods should focus on blending skills, knowledge, expertise, and literacies to prepare students for the next-generation workplace where expectations will demand mastery of multi-dimensional abilities.

21st Century Learners

Today, not only do kids need basic literacy, but also scientific and numerical literacy, visual literacy, cross-disciplinary skills, and environmental literacy. They need to know how to access and evaluate information, use and manage data, analyze media, and apply technology. Most Missouri students have access to technology in the classroom, however it's the quality of access that will determine how well they are prepared for post-secondary learning.

High-speed Internet, also known as broadband, allows users to connect to digital content in useful and meaningful ways. The National Telecommunications and Information Administration (NTIA) defines broadband as Internet access with download speeds of 3Mbps (megabits per second) and upload speeds of 768Kbps (kilobits per second), the minimum standard to be considered "high-speed." At this speed users can access basic applications like email, web-browsing, music-streaming services, and standard definition video. The chart on page four describes the download speeds, connection types and typical

21st Century Student Outcomes and Support



Network Infrastructure: Why Fiber Is Good For You

Fiber-optic cabling delivers greater bandwidth than copper because it allows data to travel faster and over longer distances with less data loss. Fiber also provides more security, reliability, and immunity from environmental factors that affect copper. Although fiber has higher installation costs, in the long run, this type of cabling costs less to maintain, requires less networking hardware, and reduces downtime.

applications associated with each level of broadband service.

Bandwidth in Missouri

In 2011, the Missouri Department of Elementary and Secondary Education (DESE) surveyed public school districts to assess their level of investment in K-12 education technologies. The census showed that 93 percent of school buildings had a bandwidth of 1.5Mbps or higher and 72 percent of schools utilized fiber connections. These figures indicate that while most kids are connected in the classroom, not all Missouri schools have the necessary bandwidth to fully embrace digital learning applications. The chart on the right describes the speed and connection needed to run various applications.

With better broadband, faculty and staff can access more professional development opportunities, utilize affordable cloud computing services, and collect and analyze student data with more ease and accuracy. Faster Internet speeds can help students who need higher-level math or science courses, Advance Placement classes, or personalized remedial support.

Maps that show broadband coverage across states and counties can be misleading. Just as a roadmap cannot help drivers avoid congestion and traffic, a broadband coverage map cannot display the quality of Internet access. The number of users on a network will impact the online experience. As more students, teachers, and staff members engage digitally, the demand for more bandwidth will increase.

The use of online learning tools, web-based content, interactive digital textbooks, and online assessments will increase digital traffic. A recent survey found that while more teachers than ever are downloading video content in the classroom, the majority report problems like skipping, pausing, or constant buffering when

Speeds Required for Application Use

Download Speed	Type of Connection	Typical Application
768k <1.5M	DSL, Cable, Fiber, Satellite, Cellular, Fixed Wireless	Basic email, low resolution video, basic browsing, VoIP
1.5M - <3M	DSL, Cable, Fiber, Satellite, Cellular, Fixed Wireless	Email, standard definition video, streaming music, remote surveillance, most web applications
3M - <6M	DSL, Cable, Fiber, Cellular, Fixed Wireless	Small file sharing, Internet protocol television, some online gaming
6M - <10M	DSL, Cable, Fiber	File sharing, online gaming, video on demand, HD IPTV
10M - <25M	Cable, Fiber	Telemedicine, remote education, HD IPTV
25M - <50M	Cable, Fiber	HD video surveillance
>=100M	Fiber	Real-time data collection, real-time medical image consulting

Source: MoBroadband.now

they stream videos. This happens because many schools lack computing devices or infrastructure that can accommodate digital learning demands.

Bandwidth Barriers

The diagram to the right illustrates why networks often fail to deliver uninterrupted Internet service. School networks have complex architectures and many potential areas where the digital transmissions can form bottlenecks. These blockages create challenges for teachers trying to implement a blended learning environment. Typical problems stem from insufficient Internet connectivity, faulty connections between the school to the district office, aging network hardware and wiring, or a limited number of access points.

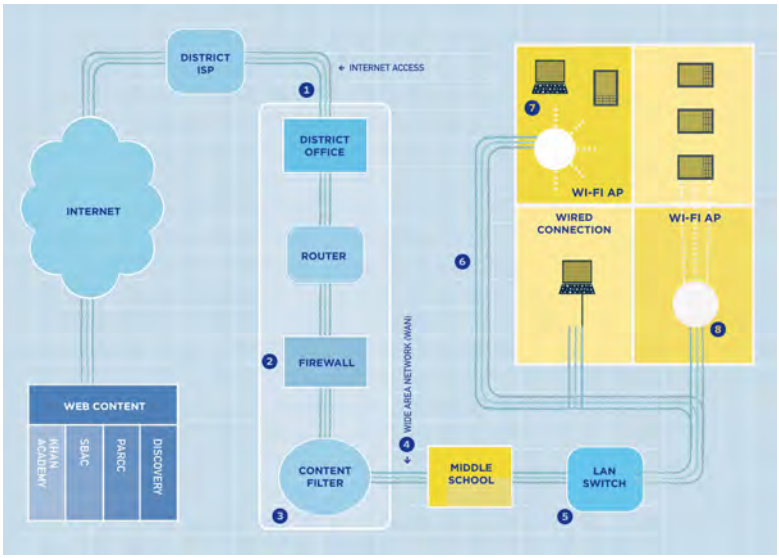
The problem only stands to worsen over the next three years. SETDA recommends that schools and districts meet a minimum bandwidth target for the 2014-15 school year of at least 100 Mbps per 1,000 students/staff. For the 2017-18 school year, the organization recommends at least 1 Gbps per 1,000 students/staff. That's an increase of ten times the current minimum target.

Since 2003, the students-per-computer ratio has nearly doubled in Missouri, placing greater demand on school networks. Without a coordinated effort to remove the bandwidth barriers facing local districts, educators intent on bringing a blended curriculum into the classroom will struggle to create unobstructed online experiences for their students.

FINDINGS

When DESE conducted its Census of Technology in 2011, the survey took inventory of equipment, usage, skill level, and Internet connectivity. The findings revealed that of the

Why Networks Fail: Blockages and Bottlenecks



Source: Education Superhighway

approximately 60,000 classrooms in the state, nearly 99 percent were connected to the Internet. The survey indicated that 90 percent of both teachers and administrators had either intermediate or advanced skill levels and 80 percent of 8th graders were technically literate. Districts also reported that technology was incorporated into at least one core curriculum an average of 95 percent of the time. Administrators use computers the most, but the chart on page six shows that the entire school

community regularly engages with information technology.

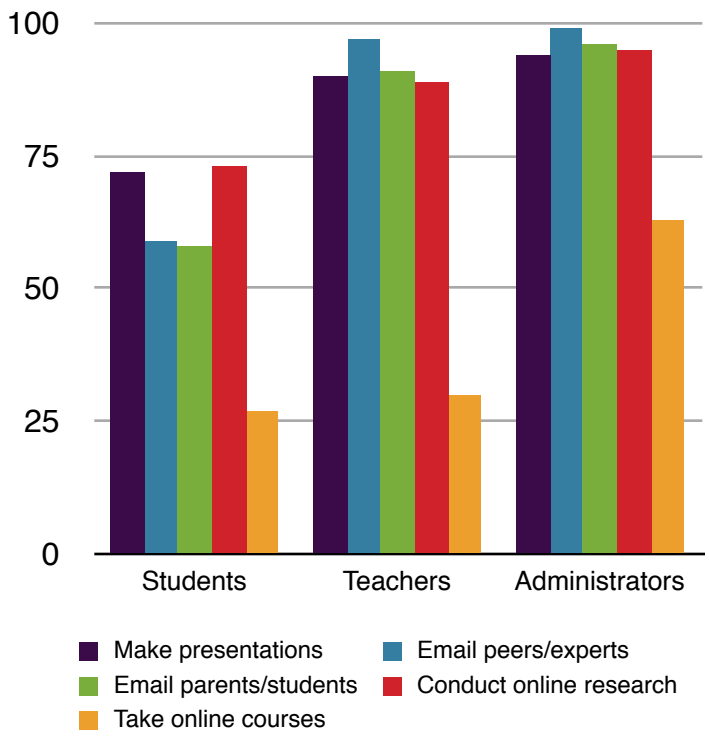
Data collected over the past eight years show that administrators, teachers, and students have increased daily use and gained greater technological literacy. A majority of students routinely conduct online research and make multimedia presentations. Nearly all administrators and teachers use computers to track and assess performance. Yet, despite growth in usage, funding allotted for technology has decreased. The graph on page seven shows the relationship between student and staff use and school budgets since 2008.

Districts have not studied bandwidth capacity. Reported broadband speeds only show school building Internet connectivity by bandwidth and delivery mode. According to DESE's last Census of Technology, 3 percent of schools have less than 1.4 Mbps, 39 percent have 1.5 - 9.9 Mbps, 28 percent have 10 - 45 Mbps, 16 percent have 45 -100 Mbps, and 17 percent have greater than 100 Mbps. The chart on page seven describes the SETDA standards for digital learning.

Competition for Capacity

Generally, studies do not consider the competition for bandwidth between users, an important factor when evaluating digital learning capacity. The following formula creates a more accurate representation of the varying degrees of digital readiness in Missouri districts. Missouri Wonk converted bandwidth into kilobits per second (Kbps) to create a standardized school speed. This figure was then divided by the total number of students, faculty, and staff that learn or work in the school; the result reflects Kbps per capita.

School Day Technology Use, 2010–2011



Missouri Wonk assigned schools a score ranging from 1-4, with a 4 representing schools with the greatest bandwidth capacity per student; these schools were then aggregated into their respective districts and the districts were assigned a 1-4 score based on the average of their schools.

The map on page eight shows digital readiness by district. School districts in dark green have an average bandwidth capacity in excess of 100

Kbps per capita, meaning they are "digital learning ready." School districts in red have less than an average of 10 Kbps per student and lack bandwidth for basic connectivity. The scale is as follows: 1=Pre-basic, 2=Basic connectivity, 3=Emerging reliance, 4=Technology rich. These scores were grouped by digital readiness according to standards established by SETDA.

THE SOLUTION: MISSOURI'S NEED FOR SPEED

The bandwidth challenge has moved from connectivity to capacity. To break down barriers and keep pace with technological change, every school should shoot for speeds in excess of 100 Mbps. Faster speeds mean more students can supplement traditional curriculums with instruction that takes them into the global classroom where rich, personalized, and engaging instruction waits. Better bandwidth brings more opportunities for professional development, cloud-based computing, and improved student data collection and analysis to faculty and staff.

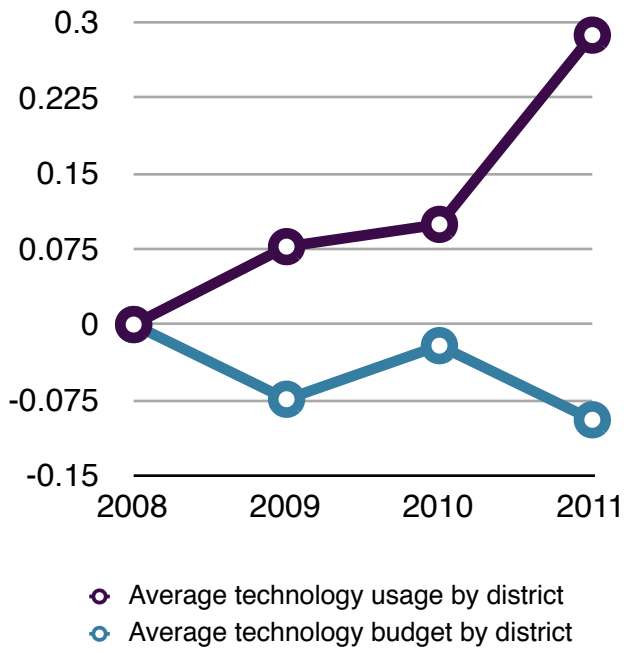
Identifying the struggling schools represents the first step. With additional resources, districts can invest in technology and talent to help them document their current hardware, locate network gaps and bottlenecks, and take steps to secure effective upgrades.

Rural schools face some of the toughest challenges because connection costs are higher in sparsely

SETDA Standards for Digital Learning

Category	Bandwidth	Example Activities
Technology Rich	100+ Kbps/student	Full 1:1; media-rich content; robust web-based projects/ courses, student management, and conferencing
Emerging Reliance	50-100 Kbps/student	Implementation of partial 1:1; dynamic content/streaming video; web projects; web based office/ student management
Basic Connectivity	10-50 Kbps/student	Rotational computer lab; basic online research and email activities
Pre-Basic	<10 Kbps/student	Basic activities; limited by bandwidth

Growing Technology Use & Shrinking Budgets

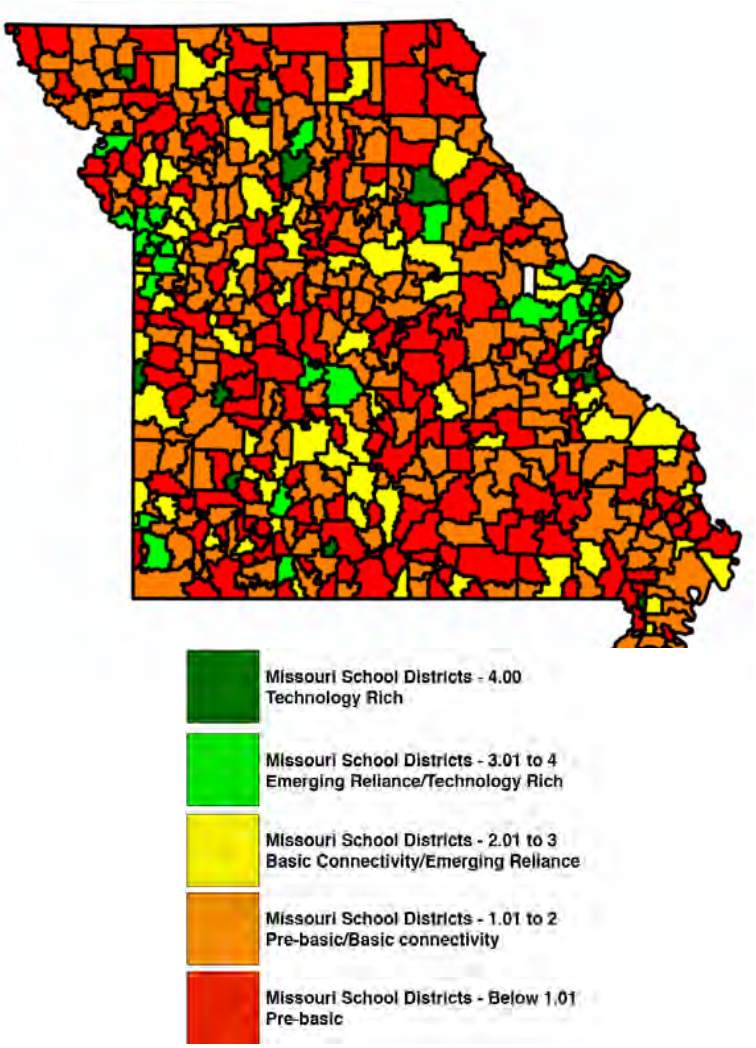


populated areas and the price for service and equipment exceeds that of non-rural areas. The rural areas of the state stand to reap some of the greatest benefits of digital connectivity.

However, schools in rural Missouri also face tight budgets and fiscal challenges, limiting their ability to fund these essential investments. By enacting a grant-matching fund, the General Assembly and DESE could help bridge the bandwidth gap by providing financial relief to districts that want to invest in current and future technologies. This fund would provide support for instructional technology upgrades, training for faculty and staff, and resources to upgrade infrastructure in buildings that fall below the basic connectivity threshold.

Efforts to raise all Missouri schools to digital readiness standards will not only breakdown the bandwidth barrier, but will also help bridge the digital divide that separates school districts and give all students, faculty, and staff an opportunity to build skills for the 21st century.

Digital Readiness by School District



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