Supporting Effective Technology Integration and Implementation

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Compared to where they were three decades ago, schools have made significant progress regarding their implementation and integration of digital technologies. That progress often has been quite slow, however. Although Apple 1 computers were donated to schools as early as 1975 (*Computers in the classroom*, n.d.), it was not until the mid-1980s that computers started to become something other than a novelty in teachers' classrooms. Technology use by educators and students continued to be relatively rare through the mid-1990s until the federal Technology Literacy Challenge Fund helped schools try to make computers available to every student (Riley, 1996). Fostered by additional funding, investment in infrastructure, multiple national educational technology plans (United States Department of Education, 1996, 2000, 2004, 2010), and concurrent growth of the Internet and home computing use, digital technologies proliferated more quickly in American schools over the last decade and a half.

Technological changes in school learning environments over the past 15 years have been substantial. For instance, in 1994 only 3 percent of public school classrooms, computer labs, and library media centers had Internet access (National Center for Education Statistics [NCES], 1997). Fourteen years later, 97 percent of public school classrooms had an Internet connection (NCES, 2010a). Student-to-computer ratios also

decreased significantly over this time. In 1996, the national student-to-computer ratio in public schools was 11:1 (United States Department of Education, 1996) but by 2009 that ratio had dropped to just 1.7 students per computer (NCES, 2010b). Today many schools are implementing so-called '1:1 programs' in which every student is provided a laptop, netbook, tablet computer, or some other handheld device. Schools that allow students to bring their own technology from home are even seeing student-to-computer ratios tip the other direction, since it is not uncommon for students to possess multiple computing devices. As students incorporate laptops, tablets, smartphones, and other digital devices into their daily learning experiences in the years to come, it will be the norm for student-to-computer ratios in schools to be 1:2, 1:3, or even lower.

Progress in other areas of school technology has been significant as well. For example, in 2002 only 9 percent of American public schools reported having students who were taking online courses (NCES, 2005). Those students accounted for a mere 328,000 course enrollments. Given that some students took more than one online course, approximately 0.5 percent of the national student population was taking an online class a decade ago. By 2009 there were an estimated 1.8 million online enrollments of traditional students and another 200,000 children taking multiple courses as students in full-time online schools (International Association for K-12 Online Learning [iNACOL], 2012). At least 5 percent of the national student population is taking at least one online course today, which constitutes a ten-fold increase in just a few years (United States Department of Education, 2012). Similarly, while in 1999 less than 10 percent of teachers reported using the Internet to access research and best practices for teaching (United States Department of Education, 2000), a decade later 94 percent of teachers reported using the

Internet 'sometimes or often' for classroom, instruction, or administrative tasks (NCES, 2010b).

As computers and the Internet have become more prevalent in American schools, many analysts' concerns have shifted from whether educators and students have access to digital technologies to how they use the learning tools that they have. Some scholars have focused on teachers' lack of usage (e.g., Collins & Halverson, 2009; Cuban, 2001; Moe & Chubb, 2009), while others note that teachers may use technology in their instruction but may not use it very well (see, e.g., Jacobs, 2010; Lemke, Coughlin, Garcia, Reifsneider, & Baas, 2009; Richardson & Mancabelli, 2011).

Standards, Models, and Frameworks

In an attempt to increase and improve educators' use of digital learning tools, some researchers and organizations have created theoretical models or standards documents to guide teachers' and administrators' practice. The dominant conceptual model used by most instructional technology experts today is Mishra and Koehler's *Technological Pedagogical Content Knowledge Framework [TPACK]* (2006), which focuses on the intersections between teachers' content knowledge, their pedagogical knowledge, and their knowledge of digital technologies. In addition to the TPACK framework, technology curricula for P-12 students, professional development initiatives for teachers, and pre-service teacher preparation programs also are typically being guided by the International Society for Technology in Education (ISTE) National Educational Technology Standards for students (NETS-S) and teachers (NETS-T) (ISTE, 2007, 2008). There also are sets of standards from ISTE for administrators (NETS-A), instructional technology coaches (NETS-C), and computer science teachers (NETS-CSE)

(ISTE 2009b, 2011a, 2011b) but these have gained much less traction in the field. Few preservice administrator preparation programs, for example, are making use of the NETS-A (McLeod, 2011).

In addition to its standards regarding what students, teachers, and administrators need to know and be able to do when it comes to digital technologies, ISTE has published a list of *Essential Conditions* (2009a) that are necessary "to effectively leverage technology for learning" (p. 1). These conditions include vision, leadership, technical support, curriculum frameworks, and supporting policies. It is ISTE's belief that school leaders who acquire and effectively implement the competencies outlined in the NETS-A will enable the environmental conditions necessary for students and teachers to thrive in their technological practice. ISTE's *Essential Conditions* list has been utilized by researchers (e.g., Borthwick, Hansen, Gray, & Ziemann, 2008; Bucci, Cherup, Cunningham, & Petrosino, 2003; Judge & O'Bannon, 2007) and provides a useful framework for examining administrators' behaviors and belief systems as they work to support technology usage by teachers and students (Thomas & Knezek, 2008).

Essential Conditions

There are 14 essential conditions described by ISTE as necessary for effective technology integration and implementation in schools. Principals and superintendents arguably are primarily responsible for the climate, culture, and other environmental characteristics that define students' and teachers' work. Accordingly, if the necessary conditions for successful technology usage are lacking in schools, administrators are the first place to look for the solution. In the sections that follow, we outline in concrete

terms a number of leadership actions that promote and facilitate powerful usage of technology for learning.

Shared vision

Facilitating organizational vision is an imperative component of any leader's role and responsibilities. When it comes to technology, any vision for powerful integration and implementation must by necessity begin with a rich understanding of the complex and interdependent characteristics of the new technology-infused environments in which schools are encompassed. For instance, our world is now digital rather than merely analog. Our interactions occur electronically and online rather than just face-to-face. We increasingly have mobile access - anytime and anywhere - through our Internet-connected devices to the entire world's information, crossing both geographic and linguistic borders. Like our individual selves, most of that information is networked and interconnected. It is also largely open and free and thus much more convenient and accessible (Willinsky, 2006).

Because the barriers to publishing are so low, billions of people now can be content creators instead of just being information consumers (Shirky, 2008). Ideas and resources blossom and create an often-overwhelming ecosphere of information, forcing us to devise new knowledge aggregation and curation tools. We are developing techniques such as 'crowdsourcing' and 'crowdfunding' that allow us to create content and tools that were literally impossible to make in the past.

Because of online and electronic learning environments, our dependency on live humans as instructors is lessening. For hundreds of millions of people whose learning needs were previously unmet, this is a tremendous blessing, particularly as informal,

technology-mediated learning opportunities become robust enough to sometimes substitute for formal, face-to-face learning institutions such as schools and universities (Christensen, Horn, & Johnson, 2008). Our learning resources now come to us in the form of interactive multimedia, including not just static and hyperlinked text but also audio, video, images, charts, diagrams, maps, games, and simulations. Our barriers to access have decreased significantly and thus our learning is more empowered because it can be more autonomous, self-directed, and personalized.

All of the developments just described, both individually and as part of the larger, commingled whole, have profound implications for how we think about learning, teaching, and schooling. Most schools are not primarily digital, however. They are predominantly locally-oriented rather than globally-oriented. Many of the devices that bring the world's information to us are banned in schools, and educators infrequently understand or use with students the technologies that are transforming everything else around us.

Principals must be purposeful and intentional about developing school internal cultures that are relevant to their external cultures. If they are to see desired movement in necessary directions, principals must be able to communicate these societal and technological shifts in emotionally- and intellectually-resonant ways to their internal and external communities. If staff, parents, and other community members lack a sense of urgency, principals must enact sustained initiatives of communication and education until long-term change mindsets are firmly in place that digital technologies are here to stay, that they are important, and that they will continuously and disruptively foster numerous changes in schooling practice. Those mindsets then must be continually nurtured and

supported in order to stave off complacency or a return to traditional modes of operating (Kotter, 2008).

Numerous avenues are available to principals to do this visioning work. In the past, school leaders wishing to find support for a change initiative would 'pound the pavement,' connecting with staff and community members face-to-face and trying to recruit allies to the cause. That face time still is critically important for technology-related change efforts, but it is also often inefficient since it depends on interactions that are primarily one-to-one or one-to-few. Principals now have new tools available to them that can increase their reach and impact. Daily sharing on a blog, weekly podcasts, monthly videos (instead of paper newsletters) to the community, and ongoing interactions on school Facebook pages all are possible mechanisms for spreading the word, drumming up support, and maintaining a sense of urgency.

Empowered Leaders

Facilitating distributed leadership structures is another critical task for principals in their roles as technology leaders. In the past, school leadership was viewed primarily as the domain of a single person in charge (Gronn, 2008). That person made decisions and then his employees carried out his orders. We now know that school organizational structures that distribute leadership functions across more people result in better outcomes, whether those be employee involvement and engagement (Hulpia, Devos, & Van Keer, 2011; Murphy, Smylie, Mayrowetz, & Louis, 2009) or student achievement (Heck & Hallinger, 2009).

Just as distributed leadership is vital for a school's operations generally, so is it important specifically for its technology functions (Levin & Schrum, 2012). Every

principal should have a technology advisory team that consists of teachers, parents, students, and interested community members. That team should have meaningful input into the school's technology-related goals and decision-making processes, including purchasing, instructional integration, professional development, and staffing for both technology support and technology integration. The technology advisory team also should be charged with collecting both qualitative and quantitative data from all stakeholders (including students), evaluating the success of the school's technology initiatives, and reporting frequently and publicly.

Another aspect of empowered, distributed leadership is the creation of structures that facilitate team members' learning. Schools that create ways to 'bring the outside in' for staff and technology advisory teams will have access to a greater diversity of ideas and resources than those that will be devised locally in-house. In their seminal book, *The Power of Pull*, Hagel, Brown, and Davison (2010) describe the incredible power of members at the outside edges of organizations bumping up against, intersecting with, and learning from individuals at other organizations' edges (see also Cross & Parker, 2004; Benkler, 2006). Online - and often informal - learning structures that span institutional barriers can be powerful ways to facilitate distributed learning and leadership. A variety of technology tools are available for this purpose, including blogs, Twitter, Facebook, wikis, webinars, and social bookmarking.

Implementation Planning

Any good technology implementation will be well-planned. However, the speed at which digital technologies change these days brings unique challenges. For example, the days of three- or five-year technology plans are probably numbered. Any school

technology plan that is not able to adapt yearly or even quicker is one that may be outdated the moment it is written. Technology planning should be organized around essential student learning outcomes and staff learning goals, not particular devices. For example, a goal statement in a technology plan might read 'To enable greater access to online learning resources by primary grade students' rather than 'To purchase 250 iPads for use in the elementary school.' Technology plan goal statements that are learning-oriented rather than tool-oriented are more flexible and can better accommodate rapid changes in available devices and systems.

A truism for all technology implementations is that schools likely never can have enough bandwidth. Principals should plan on probably upgrading the capacity of their school network yearly as student and staff computers become ubiquitous. Technology users in the organization also will be accessing more multimedia as mobile computing devices become more prevalent, thus putting additional strains on network capacity. Principals should work closely with their school technology support staff regarding technology deployment and network load management. This includes advocacy for greater bandwidth and other supports for rich technology integration by students and staff. While perhaps preservative of the integrity of the existing school network, locking or disabling access to particular sites or certain functions of the network often goes against the educational mission of school organizations. Robust conversations must be held in which principals, teachers, and students have meaningful input into the purchasing of specific learning technologies and services, the management of the school network, and access to the Internet. The National Center for Technology Planning

(*www.nctp.com*) can be a helpful resource to principals as they and their communities do the difficult work of technology planning.

Consistent and Adequate Funding

Another component of effective technology planning and implementation is ensuring a steady and adequate stream of funding. Technology-oriented grants, donations, or other one-time monies are useful for jumpstarting new programs, funding pilots, and enhancing current practice but should not be relied upon for long-term, systemic deployments. Currently schools utilize a variety of different strategies to fund their ongoing technology initiatives. Many reallocate general funds. Others rely upon facility, equipment, and/or technology levies. While the latter often are dependent on voter approval, these referenda still may be more stable revenue streams than grants, donations, or temporary set-asides. Some states have allocated portions of statewide tax revenues to help schools with technology-related purchasing and deployment. Principals and their technology advisory teams should stay abreast of any and all possible avenues for technology funding and should have a long-term goal of sustaining instructional and organizational technology initiatives through reliable funding streams rather than short-term, temporary mechanisms.

One promising trend for technology funding is that an increasing number of states now allow schools to repurpose textbook monies for digital learning devices and materials. Rather than being forced to buy paper textbooks, schools can use those funds to create or purchase electronic textbooks, laptop or tablet computers, digital learning systems, access to online services, and other learning technologies. As they gain flexibility regarding funding and usage requirements, many schools are getting creative

with their technology initiatives and are implementing more innovative programs such as wireless-enabled school buses (Dillon, 2010), mobile learning projects (Toppo, 2011), 3D printers (Dimension Printing, 2012), and 'maker labs' (Youth Radio, 2012). Similar creativity is necessary to fund and sustain these inventive programs.

Equitable Access

Equitable opportunities with learning technologies have been of concern from the beginning of their deployment in schools. Most of the attention has focused on typically-underserved students' access to computers and the Internet (e.g., Becker, 2006; Warschauer, Knobel, & Stone, 2004). Many educational policy and funding initiatives have been aimed at closing this so-called 'digital divide.' Although access gaps are smaller today than a decade or two ago (Warschauer & Matuchniak, 2010), principals still must pay attention to the issue, particularly as the emergence of new technologies often can create new disparities (Reich, Murnane, & Willett, 2012).

In addition to technology access divides, it also is common in schools to see technology usage divides. As Neuman (1991) noted,

> Economically disadvantaged students, who often use the computer for remediation and basic skills, learn to do what the computer tells them, while more affluent students, who use it to learn programming and tool applications, learn to tell the computer what to do. (p. 1)

This 'secondary digital divide' is of grave concern. Economically-disadvantaged students, students of color, linguistically-challenged students, students with special needs, and others may be particularly dependent on schools to close technology access and usage gaps since their existing economic, social, and/or cultural capital may not be sufficient to do so.

Principals must attend to both primary and secondary digital divide concerns. Otherwise already-disadvantaged students will fall further behind as our world becomes even more technology-suffused than it is already. Principals must be proactive, taking actions such as investigating potential gaps in their schools and using federal Title I and other monies to remedy access and usage disparities. Instead of giving new technology equipment and opportunities to high-achieving or already-advantaged students, schools can intentionally give academically-struggling or disadvantaged students first exposure to those learning tools.

Many schools have tried to address disparate technology access and usage at home, not just at school. For instance, some schools provide students with portable computers, subsidize mobile phone Internet subscriptions, implement wireless Internet hotspot checkout programs, or create parent education and training opportunities in a deliberate attempt to close technology and learning equity gaps. Similarly, some schools have worked with local community groups or telecommunications companies to provide discounted or free home Internet access to low-income families (McLeod, 2009). Some school districts have even provided Internet access on buses for student use to and from school. A new national nonprofit organization, Connect2Compete (*www.connect2compete.org*), has received billions of dollars in commitments from the federal government, Internet service providers, and other corporations and foundations to provide reduced-cost home Internet access and digital programming to lower-income students and their families.

Skilled Personnel

The existence of digital learning technologies in schools does not mean that educators know how to use them. Wide variability in educators' technology knowledge and skills exists both within and across school organizations. While some educators seem to be quickly fluent with any technology that crosses their horizons, others still are struggling to fairly master basic technologies such as email, file management systems, Internet browsers, and office productivity software.

Overall, teachers report that they are more fluent with digital technologies than they used to be. For example, over half of all public school teachers report that they use word processing, spreadsheet, desktop publishing, and presentation software 'sometimes or often' (NCES, 2010b). Smaller but still substantial percentages report that they use database, image editing, and simulation and visualization programs. Nonetheless, a broad continuum of faculty technology fluency persists in most schools, particularly when it comes to newer tools such as blogs, wikis, social networking, and other social media (NCES, 2010b).

One way that principals can work to ensure that they have teachers and other personnel who are skilled with digital technologies is to incorporate technology expectations into hiring and annual review criteria. For instance, many schools create detailed job descriptions and interview protocols for hiring new faculty but fail to include meaningful technology integration as an essential component of their job announcements and interview processes. Students and technology-savvy teachers should be integrally involved with the selection and on-campus interviews of potential hires. Interview protocols should include detailed questions designed to get at how and how often teacher candidates will incorporate technology into student learning experiences.

Another way for principals to influence the supply of technology-fluent teachers is to work closely with teacher education programs. As schools create technology-rich learning environments and focus more on higher-order thinking skills, many administrators are finding that preservice programs have not adapted yet to provide new graduates with skills relevant for their classrooms. For example, when asked how well their teacher education program prepared them to make effective use of technology for instruction, only 33% of public school teachers replied 'to a moderate or major extent' for their graduate program and only 25% of public school teachers reported the same for their undergraduate teacher education program (NCES, 2010b). Principals should initiate constructive, non-threatening dialogues with university faculty and administrators about the technology skill sets that they need new teachers to have. Re-aligned postsecondary curricula, joint research initiatives, observation programs, mentoring systems, internships, partnerships, and political advocacy platforms are just some of the potential outcomes of such conversations.

Ongoing teacher observation and evaluation processes should stress that technology integration is a core component of educators' work rather than an optional or marginal add-on. In order for that to occur, principals must be able to identify and differentiate between effective technology usage by students and teachers and simply using technology for technology's sake. Principals also can facilitate school wide discussions, the creation of videotaped exemplars, and other mechanisms to foster explicit recognition and analysis of relevant, authentic technology integration. Additionally, school leaders should facilitate appropriate assistance and intervention opportunities for teachers that are struggling to meaningfully integrate digital

technologies into their classrooms. These might include technology 'boot camps' that focus on specific skills, ongoing mentoring, and other professional learning mechanisms.

Ongoing Professional Learning

Whether they are trying to remediate gaps in their knowledge and skills or extend and enhance those that they already have, all teachers deserve rich professional learning opportunities related to technology. Unfortunately, the majority of public school teachers report that they receive eight hours or less of technology-related training per year; one in seven reports no technology training whatsoever (NCES, 2010b). In an era when digital technologies, workforce demands, and other societal factors are changing quite rapidly, low exposure to technology-oriented professional development opportunities does nothing to ameliorate schools' typically-sluggish rates of change.

Principals need to find ways to continually nurture and upgrade their teachers' technology knowledge and skills. If funds are limited for more-traditional mechanisms such as sending faculty to state or national educational technology conferences, plenty of other opportunities abound. For instance, principals could work with other local leaders to facilitate regional or in-house technology workshops. Every school has teachers that are technologically-fluent. Typically those teachers are more than happy to share their skills and talents with their peers. Whether it is through after-school training, release time during the school day, participant-driven 'unconferences,' or other structures, principals should find ways for their technology-savvy faculty to teach and facilitate other teachers within their building.

In addition to utilization of internal technology integration expertise, principals often bring in outside experts to train teachers how to use specific technology tools.

These may be provided by vendors or may be independent national-level trainers or consultants. Regardless of the provider, technology training experiences always should comply with best practices regarding adult learning. Like for non-technology related training, technology professional development should occur within learning communities, be differentiated by learning needs, facilitate active engagement by participants, be recurrent and build upon past learning rather than only occurring once, be aligned with desired curriculum standards, and be rooted in learning and teaching needs rather than the technical aspects of a particular tool (Learning Forward, 2011).

One of the very best ways to facilitate teachers' technology learning is to have dedicated technology integration personnel. Technology integration personnel usually have advanced training related to teaching with technology and have different skill sets than those technical support personnel charged with hardware, software, or network maintenance and troubleshooting. Whether technology integration personnel are staffed within a particular building or shared with other buildings across a larger system, teachers better integrate technology into their classrooms when they have regular access and exposure to such individuals (e.g., Hew & Brush, 2007; Zhao, Pugh, Sheldon, & Byers, 2002). When it comes to technology, most school organizations invest in technical support but lack a concurrent commitment regarding teacher integration. Whether due to a lack of funding, knowledge, or vision, this underinvestment perpetuates teachers' infrequent and/or shallow use of learning technologies within their instructional practice (Collins & Halverson, 2009; Cuban, 2001). Principals must recognize that technology purchases require parallel investments in educator capacity-building in order to maximize usage.

If dedicated technology integration personnel are unavailable, other possibilities still exist for schools. Hughes and Ooms (2004), for example, facilitated teacher inquiry groups in which teachers teams of similar content and grade area worked to find technology-supported solutions. These groups experienced great success as they engaged in action research projects designed to support their technology integration experiences. Other alternatives might be to create student-led technology support teams or to assign a student technology mentor to every teacher. Organizations such as Generation YES (*www.genyes.org*) work with schools around the world to implement student-driven technology support structures.

In addition to providing formal technology learning avenues for teachers, principals also should strive to connect their faculty with informal opportunities as well. Many educators are finding great value in online, networked learning spaces, sometimes called Personal (or Professional) Learning Networks (PLNs). Using tools such as webinars, blogs, RSS readers, Twittee, and social networks, teachers are connecting with each other within PLNs in ways that were impossible prior to the advent of the Internet. Communities of practice are emerging that are global rather than just local. As illustrated by the extraordinary enthusiasm of many of the educators participating in these loose, diffuse networks, helping teachers connect with other role-alike peers around the world can have transformative impacts on their instructional practices. Research shows that administrators who are trained in and model the use of digital technologies often see increased usage by teaching faculty (Dawson & Rakes, 2003). Principals should be active participants themselves when it comes to our new technological landscape.

Technical Support

Although school systems invest in technical support personnel much more often than they do technology integration personnel, public schools still typically are understaffed compared to for-profit and other institutions. This state of affairs leads to personnel-to-computer support ratios that dwarf those found in private organizations. It is not uncommon for public school technology personnel to support 600 to 1,500 computers apiece (Stansbury, 2008). This compares quite unfavorably to their counterparts in industry or private schools who may only manage between 40 and 200 computers each (Apel, 2009; McLeod, 2003). Some schools have outsourced their technology support and/or integration functions to private vendors, regional educational service agencies, or other entities. Schools are constantly at risk of technical support personnel succumbing to burnout or leaving for greener pastures elsewhere. Given the difficulty of hiring and keeping replacements, principals should do everything possible to nurture, support, assist, and retain technical support staff members. The Consortium for School Networking (*www.cosn.org*) has a wealth of free tools available to principals and technical support staff related to leadership, planning, and staffing.

Despite their best intentions, technical support personnel often are accused of being gatekeepers or blockers when asked by teachers or administrators to enable technology-related learning opportunities. Citing the demands of safety, security, network integrity, bandwidth, and other factors, technical personnel are perceived as denying students and educators the chance to engage in powerful learning through use of the Internet and other digital technologies. Sometimes these responses are due to sheer time and work overload. Other times such responses are a result of genuine disagreement over the utility or wisdom of allowing certain learning opportunities to occur. Principals

should engage in constructive dialogues with technical support personnel, recognizing their needs and concerns but affirming at all times that the technology function of the organization is there to serve the educational function, not the other way around. Strong, visible leadership support can alleviate technical support staff members' concerns that they will be blamed if a negative incident occurs.

Curriculum Framework

Technology usage in schools always should be in service of instructional and curricular goals. Unfortunately, many learning technologies are purchased without careful consideration of how they will facilitate and enhance organizational learning objectives. Technology purchasing and deployment should be informed by the needs of students and teachers, not just administrators. Principals and superintendents should ensure that both instructional and administrative management technologies are chosen with due concern for the requirements of end users.

An issue that frequently arises related to technology purchasing is administrators' susceptibility to vendor pitches. Tales of principals or superintendents buying hardware and software for their schools without consulting classroom educators or technology support personnel are legion. Whether this occurs because of administrators' own lack of technology fluency, an unwillingness to involve teachers and other staff, or other reasons, any technology that is purchased without involvement of the people that will be using it runs a high risk of being used infrequently at best. Before making any sizable technology purchase, principals should ensure that teachers, students, administrative assistants, and other end users are meaningfully included in the decision-making process.

Attempts to align particular computer tools with various instructional or curricular frameworks are not uncommon. These lists purport to identify specific technologies that are appropriate for teaching certain topics, skills, or levels of thinking. Sometimes tools such as The Geometer's Sketchpad (*www.dynamicgeometry.com*) or the iCivics web site (*www.icivics.org*) are indeed only relevant for certain courses. Principals should be aware, however, that most non-subject-specific learning technologies can be used for a variety of instructional purposes. There are few general technology tools that only are suitable for lower- or higher-order thinking tasks, for example. Where a technology falls along an instructional or curricular continuum nearly always depends on how that technology is used by the teacher.

Management software also can be used to facilitate curricular and instructional goals. Plano, Texas Independent School District, for example, maintains for its teachers an online database of effective lessons and activities connected to curricular standards (*http://k-12.pisd.edu/curriculum.html*). Curriculum alignment software, electronic grade books, formative assessment tools, student information systems, learning analytics, data warehouses, adaptive learning systems, parent portals, and standards-based grading software are just a few of the many technologies available to principals to enhance the instructional and management functions of their schools.

Student-Centered Learning

Although most learning technologies are general enough to be used quite flexibly, by design some technologies are more teacher-centric rather than student-centric. For instance, tools such as interactive whiteboards, student response systems, digital projectors, and document cameras are technologies designed to facilitate the presentation

of material by one teacher to many students. Even when a student rather than a teacher is using the technology, the vast majority of children usually are passively watching the facilitator rather than actively using the technology themselves. Similarly, tools such as DVD players, pre-selected online videos, pre-filtered web sites for research, and content management systems usually are implemented in ways that are more teacher-directed rather than student-directed. Teacher-centric technologies mirror traditional educational practices related to information transmission and - unlike laptop or tablet computers, digital cameras or camcorders, scientific probeware, and other technologies that typically are used primarily by students - are generally replicative rather than transformative. Principals should strive to create opportunities for students to have greater autonomy and ownership over how and when they use technology tools. It is important for teachers to use technology in their instruction in ways that are meaningful, relevant, and powerful. It is arguably more important, however, to empower students to do the same. Schools that mostly invest in teacher-centric rather than student-centric technology tools will struggle to adequately prepare graduates who are ready for a hyperconnected, hypercompetitive, technology-infused global information society.

Many schools are trying to give every student a mobile computing device. These programs usually give students a laptop, netbook, or tablet computer. A few smartphone pilot programs also are in place around the world. Regardless of the device provided, educators in such programs are finding that technology can facilitate incredible opportunities to enable student agency and voice. As students' autonomy and ownership of their learning experiences increases in conjunction with their access to powerful technology tools, their ability to do more authentic, real-world work is greatly improved.

Schools that enable student-centered instructional and curricular processes along with regular access to robust computing devices typically find that student academic engagement is extremely high and that traditionally-desired learning outcomes often are enhanced (Sauers & McLeod, 2012). New school models such as those in the High Tech High (*www.hightechhigh.org*), New Tech (*www.newtechnetwork.org*), and other networks can give principals glimpses of what all schools may one day be like.

Assessment and Evaluation

Any technology implementation should include measures for evaluating its success. Those measures should focus primarily on classroom integration and learning goals and should be created and monitored with student and teacher input. The overall goal of any technology deployment should not be to merely make technology available to students and teachers but also to make sure it is used and used well. Among others, evaluation measures should address essential integration metrics such as frequency of use ('how often do students and teachers use technology for learning and teaching purposes?'), type of use ('what do students and teachers do when they use technology?'), and depth of cognitive work enabled by such use ('are learning technologies being used for deeper learning or merely low-level thinking work?').

Summative outcome measures and progress monitoring benchmarks can be identified for all technology deployments. Both qualitative and quantitative data on a variety of different metrics should be gathered, with particular attention given to student technology usage, learning outcomes, and perceptions. Data collection should be the responsibility of all staff and should be coordinated and analyzed by the principal and the school's technology advisory team. Regular public reports should be made to school

board members, parents, and the general community. The emphasis of all data collection, analysis, and reporting should be on learning, growth, and improvement, not on allocating shame or blame. The Consortium for School Networking (*www.cosn.org*) has free toolkits available for principals who are concerned with return-on-investment and other productivity analyses.

Engaged Communities

Social media and other technologies can be excellent vehicles for fostering community engagement. For instance, Cox (2012) found that many school leaders are leveraging social media in powerful ways with both external and internal stakeholders. Principals increasingly are using tools like Facebook, YouTube, blogs, and Twitter to connect with students, staff, parents, and community members. These tools generally have an immediacy, visibility, and authenticity that more-traditional communication channels may lack. New communication technologies thus are frequently more impactful than weekly flyers, email listservs, stagnant web sites, and local cable television channels (Stock, 2009). Corporations and non-profits can serve as models for principals who wish to enhance their school's technology-facilitated communication strategies.

In addition to new information-sharing and interaction spaces, principals also have access to new information-gathering tools. Crowdsourcing community members' input through the use of wikis, blog comment areas, online surveys, virtual chat areas, or Twitter are just some of the possible mechanisms for collecting feedback on proposed policies or activities. The more involvement that relevant stakeholders have in the development of ideas and actions, the more buy-in there will be regarding implementation of needed changes. Social media and data collection technologies can be

excellent tools for facilitating community members' engagement. Additionally, virtual book clubs with faculty or parents can be fantastic opportunities to facilitate needed discussions on important topics.

Support Policies

Numerous internal policies are necessary to facilitate effective technology integration and implementation. Any school policy related to student learning or teachers' pedagogy should include references to digital technologies. Any policy relating to educators' correspondence with students, parents, and the world at large should reference electronic communication channels. Any policy relating to student or teacher privacy concerns should reference school-provided computing devices and networks as well as off-campus uses of social media and other technologies. And so on. Principals, superintendents, and school board members should review every school and district policy to assess its potential connection to today's technology-suffused information landscapes and learning environments.

Most internal policy reviews should focus on three primary concerns. The first concern is one of relevance: does the policy make sense given how the world works today? Internal policies that operate under old assumptions, ignore modern realities, or try to preserve outmoded ways of thinking and being will need substantial revision. The second primary concern for school leaders when they review internal policy relates to support and empowerment: does the policy get in the way of enabling powerful learning opportunities for students? Some internal policies may be based on misunderstandings of how modern technologies operate or on misconceptions about youth, media, and technology. These, too, will need significant modification. The third primary concern

relates to messaging: does the policy send the message we want? School leaders always should remember that policies send messages about what their organization values (Martinez, 2008). Many current school technology policies are rooted in unsubstantiated fears. Principals should recognize that they probably do not want to send their communities the message that the technologies that are transforming everything around us should first and foremost be feared. Principals who are engaged in this difficult policy revision work should be prepared for contentious discussions as committee members likely will vociferously disagree with each other about desired outcomes, the means to achieve them, and the role that digital technologies should or should not play in the process.

Principals can serve extremely important educational roles when it comes to policy evaluation and implementation. When board members, parents, staff, or the community expresses concerns about certain technology-related aspects of schooling, principals can educate and inform them about the needs of today and tomorrow, not just romanticized notions of yesteryear. Whether we like it or not, the Internet and digital technologies both are here to stay. Their influence on how we live, work, think, and play will continue to increase. Either we learn to accommodate these tools as educational organizations or we expose our irrelevance to our children's futures. Stakeholders that attempt to effectively block out these tools from children's learning experiences are denying students opportunities to be appropriately prepared for their lives when they leave school. Overzealous blocking and filtering, for example, has very real and significant impacts on information access, student learning, pedagogy, ability to address required curricular standards, and teachers' willingness to integrate technology into their

instruction. Similarly, 'walled garden' online environments not only prevent the occurrence of serendipitous learning connections with the outside world but also create artificial communication spaces that are a mere shadow of how the Internet really works. Principals should do everything they can to create internal policy environments that are supportive of students' and teachers' current and future needs.

Supportive External Context

In addition to the work that school leaders must do within their educational organizations, they also must educate and advocate in their local and larger external community. Administrators need to bring parents and community members on board. They also must successfully educate local school board members and state and federal policymakers. Many changes in local, state, and federal policies must be made in order to productively transition schools and communities into this digital, global world that we all now inhabit.

Right now most school leaders are not actively involved in state or federal policy discussions. They rely instead on their organizations and membership associations to serve as the voice of both themselves and their communities. In the years to come, principals will need to play a much more active role in policymaking conversations if we are to see the schooling changes necessary for our new information, economic, and learning landscapes. Although external policymaking is an area in which principals have much less direct control, its importance cannot be overstated. As we live through seismic shifts in nearly everything we do, our laws and policies are struggling to keep up. Right now we have people making decisions and enacting policy about technologies and

environments that they don't really understand. Principals' individual education and advocacy efforts never have been more imperative.

One technique that principals can use to help convince skeptics about the power of learning technologies is to frequently and visibly highlight the amazing work that their students are doing with digital tools. Student displays at school events, demonstrations to school boards, presentations to legislators, and ongoing sharing through various electronic communication channels such as school blogs, Facebook pages, and Twitter feeds can be powerfully persuasive. It is difficult for people to understand the learning power of digital technologies - and easy to dismiss their instructional utility - if they are not familiar enough with the tools to understand their positive affordances. Principals and their staff and students must regularly remind others of why learning technologies are important.

Conclusion: Preparation, Training, and Support Concerns

A number of the competencies necessary for principals to effectuate ISTE's essential conditions for effective technology integration and implementation are delineated in both ISTE's own NETS-A standards (ISTE, 2009a) and the *Educational Leadership Policy Standards* (Council of Chief State School Officers, 2008) which guide most states' licensure requirements for principals and superintendents. As we have tried to show through our inclusion of concrete action ideas in this chapter, principals will have to be deeply knowledgeable and highly skilled in a number of different areas in order to accomplish these complex, technology-oriented leadership goals. Unfortunately, right now principals have few places to turn to enhance their own knowledge and skills when it comes to technology leadership. The educational leadership preparation programs

at most universities, for example, lack both the faculty expertise and the coursework to prepare technology-savvy administrators (McLeod, Bathon, & Richardson, 2011). Most national and state educational leadership associations, state departments of education, and school districts are not investing heavily in the development of technology-fluent principals and superintendents. While there are annual educational technology conferences in most states, they generally focus on teachers, technology coordinators, and media specialists. Rarely is there a dedicated strand or a separate conference for administrators. The research literature on effective technology leadership is quite sparse (McLeod & Richardson, 2011; Richardson, Bathon, Flora, & Lewis, in press), as is corporate or foundation funding for school technology leadership training programs.

Our underinvestment in principals as school technology leaders is troubling. Scholarly research has shown quite consistently that school leadership is "second only to teaching among school-related factors in its impact on student learning" (Leithwood, Louis, Anderson, & Wahlstrom, 2004, p. 3). We know that principals' leadership of both learning and organizational transformation is necessary for significant, long-lasting changes in classroom cultures and student outcomes (e.g., Duke, 1987; Hallinger, 1992). If as a society we want effective technology integration and implementation to occur in our schools, we must begin by recognizing that ultimately it is principals and superintendents, not teachers, that control all of the resources necessary for systemic change, including vision, money, time, professional development, personnel allocation, and internal policy. Most principals currently are struggling when it comes to the extremely complex and challenging work of creating and maintaining technology-rich

learning environments (Levin & Schrum, 2012). They deserve better support from all of us.

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