



Indicator: Instructional teams determine which digital learning tools (hardware) are appropriate based on device availability, Internet and broadband access, and device use policies (such as “bring your own device”). (A2)

Explanation: Establishing a comprehensive digital infrastructure includes strong leadership and careful consideration of the types of devices to purchase given the degree of broadband access, available budget, student needs, and device use policies. Without sufficient broadband access, students are unable to use digital devices to engage in higher-level learning. One-to-one ratios of students to devices are likely ideal, and may be achieved through technology purchases or accomplished through policies such as “bring your own device” to school.

Questions: What types of instructional teams should select digital tools? What level of broadband access is ideal for digital tool use in schools and in students’ homes? How many devices are ideal for student learning? How can bring-your-own device policies enhance digital learning, and what are the pitfalls of these types of policies?

Learner-centered, or personalized learning refers to “tailoring learning for each student’s strengths, needs and interests—including enabling student voice and choice in what, how, when and where they learn—to provide flexibility and supports to ensure mastery of the highest standards possible” (Patrick, Kennedy, & Powell, 2013, p. 4). The student is actively involved with the teacher in co-constructing their individualized learning pathway, and the location, time and pace of learning may vary from student to student (Redding, 2016). This process may build student agency, or the willingness of students to actively invest in, and take ownership of, their own learning; student agency has been linked to positive college and career readiness outcomes (Thigpen, 2014). Technology makes personalized learning approaches possible at scale and can assist in all areas of teaching and learning, including student data and assessment, curriculum selection and alignment to standards, and instruction and learning (Wolf, 2010; Redding, 2014). A good deal of research evidence has supported the use of technologies to increase student achievement (e.g., Tamin, Bernard, Borokhovski, Abrami, & Schmid, 2011). Recent preliminary research also suggests that personalized learning practices that incorporate technology and online curricula, when implemented with fidelity, may result in positive and large student achievement gains, particularly for students behind academically (Greaves, Hayes, Wilson, Bielniak, & Peterson, 2012; Pane, Steiner, Baird, & Hamilton, 2015).

However, while there is strong potential for digital tools’ impact on learning, it only creates the opportunity for positive outcomes. Schools must match their digital learning needs with appropriate devices that promote learning for all students through a comprehensive digital infrastructure (Grant & Basye, 2014; Thigpen, 2014). Strong leadership capable of developing this infrastructure along with a shared vision of all community members is required in order for technology to truly transform learning (U.S. Department of Education, 2016). Education leaders themselves also need “personal experience and training with learning technologies, an understanding of how to employ these resources effectively, and a community-wide vision for how technology can improve learning” (U.S. Department of Education, 2016). School leaders must organize instructional technology teams in which teachers (and others where appropriate, e.g., media specialists, students, parents etc.) are tasked with selecting digital tools; this process can

help increase the effectiveness of implementation as well as ensure crucial teacher, student and parent buy-in (Overbay, Mollette, & Vasu, 2011; Grant & Basye, 2014). School leaders and Instructional technology teams selecting appropriate digital tools must consider a variety of factors, including broadband access, device availability, and device use policies.

Broadband Access

One critical aspect of selecting digital tools is the degree of broadband access within the school, which is essential to allow students and teachers to leverage high quality learning resources and engage with the global community (Thigpen, 2014). The recent U. S. ConnectED initiative (US Department of Education, 2016) was designed to promote equitable access by connecting 99% of students with adequate broadband, high speed Internet. The government's E-Rate program was also infused with billions of dollars in 2014 to help districts improve the speed of, and access to Internet connectivity; however, approximately one-quarter of schools still lack sufficient broadband to take advantage of modern digital tools to promote learning (Education Superhighway, 2015). Similarly, many homes lack high speed connectivity, leaving many children, particularly those in low-income, non-white and rural communities, without the capacity to use digital tools for homework and school projects (Thigpen, 2014). A recent initiative, ConnectHome, launched by the U.S. Department of Housing and Urban Development (HUD), seeks to bring high-speed Internet access to low-income homes. This public-private collaborative project is bringing broadband access, training, and digital literacy programs to families of school-aged children living in HUD-assisted housing across the country (U.S. Department of Education 2016). It is critical that teachers and students have fast and reliable Internet access in order to use a wide range of digital tools, including learning and content management systems, video streaming, social networks, cloud capabilities, and online communication and videoconferencing tools (Thigpen, 2014).

Device Availability and Device Use Policies

When school teams consider technology purchases, they also must consider their students' ages and learning needs, as well as the types of ongoing learning activities that will occur in the classroom and/or after school programs. Educators must also weigh budget limitations against the likely benefits of device use for student learn-

ing (Grant & Basye, 2014). Recent literature suggests that a one-to-one ratio of devices to students combined with effective implementation is likely ideal for improving student outcomes, with schools in this category reporting increased test scores and graduation rates, as well as decreases in disciplinary actions and dropout rates (Greaves, et al., 2012). A recent meta-analysis of research on one-to-one laptop programs also found these programs, when well-integrated with curricula and with plenty of professional development for teachers, led to increased achievement in science, writing, math and English; enhanced student engagement and enthusiasm; and more student-centered and project-based instruction (Zheng, Warschauer, Lin & Chang, 2016). Educators implementing one-to one device programs must consider whether to allow students to bring their devices home; program effectiveness may be diminished if student use is restricted to the school building (Grant & Basye, 2014). While one-to-one programs may be ideal, schools face a number of challenges when attempting to implement one-to-one policies. Districts have faced issues with sufficient funding to pay for devices, lack of enough bandwidth to support all students using their devices simultaneously, and poor planning in distribution and management of so many devices (Herold, 2016).

To address some of these concerns, some schools have implemented "bring your own device" (BYOD) policies to allow and encourage students to use their personal digital devices for learning at school. While many educators have resisted these policies because of concern about distractions and/or network security, evidence suggests that the trend is growing in many schools across the country (Project Tomorrow, 2012; Grant & Basye, 2014). Schools implementing BYOD policies need strong leadership and substantial planning in order to avoid potential pitfalls that can arise with these policies. Some examples include inequity (some students' families may not be able to afford a device for their children), student distractions that can inhibit learning, and students using a range of different devices with different capabilities, which can cause an instructional burden for teachers. In addition, student devices may lack appropriate safeguards for storing their learning data, and may not have the security features that are required for valid student assessment (U.S. Department of Education, 2016)

References and other resources

- Education Superhighway (2015, November). *2015 state of the states: A report on the state of broadband connectivity in America's public schools*. Retrieved from http://stateofthestates.educationsuperhighway.org/assets/sos/full_report-55ba0a64dcae0611b-15ba9960429d323e2eadbac5a67a0b369bedbb8cf15d-dbb.pdf
- Grant, P., & Basye, D. (2014). *Personalized learning: A guide for engaging students with technology*. International Society for Technology in Education. Retrieved from <http://www.iste.org/handlers/ProductAttachment.ashx?ProductID=3122&Type=Download>
- Greaves, T. W., Hayes, J., Wilson, L., Gielniak, M., & Peterson, E. L. (2012). *Revolutionizing education through technology: The project RED roadmap for transformation*. International Society for Technology in Education. Retrieved from http://one-to-oneinstitute.org/images/books/ISTE_Book.pdf
- Herold, B. (2016, February 6). Technology in education: An overview. *Education Week*, 35(20). Retrieved from http://www.edweek.org/ew/issues/technology-in-education/?qs=technology+in+education:+an+overview+inmeta:Cover_year%3D2016+inmeta:Authors%3DBenjamin%2520Herold
- Overbay, A., Mollette, M., & Vasu, E. S. (2011). A Technology Plan That Works. *Educational Leadership*, 58(5), 56–59.
- Pane, J. F., Steiner, E. D., Baird, M. D., & Hamilton, L. S. (2015). *Continued progress: Promising evidence on personalized learning*. Santa Monica, CA: RAND Corporation. Retrieved from http://www.rand.org/pubs/research_reports/RR1365.html
- Patrick, S., Kennedy, K., & Powell, A. (2013). *Mean what you say: Defining and integrating personalized, blended and competency education*. International Association for K-12 Online Learning. Retrieved from <http://www.inacol.org/wp-content/uploads/2015/02/mean-what-you-say.pdf>
- Project Tomorrow, and Blackboard, Inc. (2012). *Learning in the 21st century: Taking it mobile!* Retrieved from http://www.blackboard.com/resources/k12/k12_pt-mobile_web.pdf
- Redding, S. (2014). *Personal competency: A framework for building students' capacity to learn*. Philadelphia, PA: Center on Innovations in Learning. Retrieved from http://www.centeril.org/publications/Personal_Competency_Framework.pdf
- Redding, S. (2016). Competencies and personalized learning. In M. Murphy, S. Redding, & J. Twyman (Eds.), *Handbook on personalized learning for states, districts, and schools*. Retrieved from www.centeril.org
- Tamin, R., Bernard, R., Borokhovski, E., Abrami, P., & Schmid, R. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. *Review of Educational Research*, 81, 4-28.
- Thigpen, K. (2014). *Creating anytime, anywhere learning for all students: Key elements of a comprehensive digital infrastructure*. Washington, DC: Alliance for Excellent Education. Retrieved from <http://all4ed.org/wp-content/uploads/2014/06/DigitalInfrastructure.pdf>
- U.S. Department of Education, Office of Educational Technology (2016). *2016 National Education Technology Plan: Future reading learning-reimagining the role of technology in education*. Retrieved from <http://tech.ed.gov/files/2015/12/NETP16.pdf>
- Wolf, M. (2010). *Innovate to educate: System [re]design for personalized learning. A report from the 2010 symposium*. Washington, DC: Software & Information Industry Association. Retrieved from <http://www.ccsso.org/Documents/2010%20Symposium%20on%20Personalized%20Learning.pdf>
- Zheng, B., Warschauer, M, Lin, C., & Chang, C. (2016). Learning in one-to-one laptop environments: A meta-analysis and research synthesis. *Review of Educational Research*. Advance online publication. doi: 10.3102/0034654316628645.

