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Policy analysis from SREB's 10 Issues in Educational Technology

Emerging Technologies and New Learning Models That Engage Students

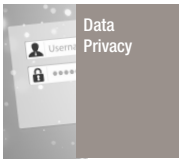
Research shows that many of today's emerging technologies and new learning models encourage students to engage more deeply in their learning, and in fact to learn more. This is increasingly important, as evidence shows that states are not reaching their goals with traditional methods. Even with recent dramatic improvements in high school graduation rates, measures of college and career readiness remain unacceptably low.

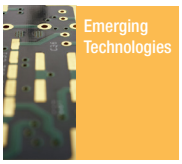
In nine SREB states where 100 percent of high school seniors took the ACT assessment in 2017, high school graduation rates had improved, but by contrast ACT college-readiness benchmarks were very low. According to the Organisation for Economic Cooperation and Development (OECD 2015), the United States ranks 11th globally in higher education attainment among developed countries. If SREB and the nation are to reach their goals for higher education attainment, we will need to find ways to engage high school students more fully in their learning, so they are better prepared for higher education.

Discussing the nature of the change that is underway, Michael Horn and Clayton Christensen in their book *Disrupting Class* noted that education was ripe for what they call "disruptive innovation." Horn recently defined this as "a process that transforms things that were complicated, expensive, centralized, and deeply inaccessible, into things that are far more convenient, affordable, accessible, and simple, such that it blesses the lives of many who never had access to the original." Adequate broadband connectivity, availability of connected devices, improved digital content, and innovative learning models enhanced by technology can make this kind of disruption not only possible but inevitable.

Inside

This policy brief is one of several forthcoming briefs on SREB's Educational Technology Cooperative's 10 Issues in Educational Technology. This report covers two issues, New Learning Models and Emerging Technologies. The remaining issues to be featured are: Data Systems, Predictive Analytics, Bandwidth and Student Digital Literacy.





Certainly, the ingredients for change are in place. SREB states *need* ways to improve student outcomes; they have innovative *ideas* that are backed by evidence and research; most have sufficient *technology* and supportive technology infrastructure.

Enhancement vs. Transformation in Digital Learning

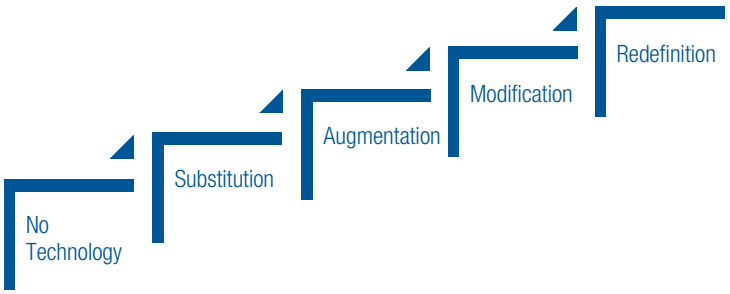
Over time, new technology tools can transform student learning. The process begins by substituting technology tools for more traditional ones. The new tools augment learning and finally transform it, leading to redesigned and more personalized outcomes. Students experience deeper learning and feel greater ownership of their educational paths, along with greater synthesis of knowledge in student-created projects and portfolios.

Too often, traditional classrooms lag behind in mainstream adoption of technologies that can unlock the full educational potential of a classroom — even as the students use the same devices for other purposes in leisure time. This is a missed chance. With the right nudge, new technology tools can change students' learning — from passively absorbing what a teacher delivers to discovering and applying those lessons in new ways, evaluating and synthesizing multiple ideas.

Researchers have recognized a pattern of teacher and student interaction with new technology tools. In 2006, Ruben R. Puentedura introduced the SAMR model of technology integration: substitution, aug-mentation, modification, then redefinition. As the tools are first introduced for educational use, educators substitute a new technology practice for a current one. Then teachers or students figure out how the tool will help them augment — extend or become more efficient — in relation to their practice. Eventually teachers and students discover how the tool can be modified to help them do something entirely new. It is then that the tool takes on a transformation role in student learning. They begin to re-define the tool for their own purposes — to use it in a different, perhaps more innovative, way than first envisioned.

Mobile phones are an example of both the SAMR model and a disruptive innovation. Early mobile phones, around 1980, were designed for automobiles, even though they were not connected to cars. Some came in carrying bags because they were large and heavy, and too unwieldy to carry. They substituted for land-line and pay phones, giving business people instant communication on the road. Business consumers soon called for phones to augment more general business mobile communication. Though still bulky by today's standard, the lighter next-generation mobile phones could be moved more easily, and they soon augmented communication for both business consumers and the general public. With the advent of smaller batteries, voicemail and texting capabilities, consumers and entrepreneurs transformed the phones into highly mobile devices allowing callers to communicate with people even if they did not catch them at their devices. As cell phones gained processing capacity and were able to

FIGURE 1: SAMR Model



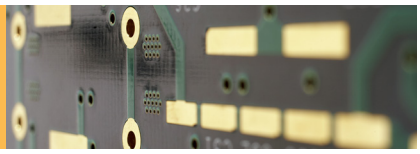
support auxiliary functions, consumers wanted calendars, clocks, cameras, flashlights and the internet at their fingertips, and these preferences led to mobile apps for every imaginable purpose. Today's smart phone has transformed how we interact with the world, and has replaced pagers, palm pilots, watches, digital cameras, video cameras and global positioning systems (GPS).

Online education also fits both the SAMR and the disruption model. In the early 1990s online education was generally approached as a substitute for classroom instruction. Teachers used the same kinds of lectures, presentations, handouts and assignments in their online classes as in their face-to-face classes. In the augmentation stage, online teachers began to realize that the online environment gave them some advantages and presented some obstacles. In learning to maximize the advantages and overcome the obstacles, they made full use of the functional advantages the technologies offered. These included automated grading applications for objective tests, tracking student participation electronically, and managing online test banks. Learning management systems (LMS), which became available in the mid- to late- 90s, disseminated information to students, while they gathered resources and recorded grades and attendance. The LMS also began to capture data about students' learning experiences. The data from these resources brought about instructional redesign and led to significant course modification. Better digital content, interactive software applications, and better bandwidth also made it possible for the instructors to create better projects or assignments. Data collected in the LMS and student information systems provided better insight about learning. These insights spurred the faculty to redesign their courses and teaching. The redefinition stage — with the use of the technology — allowed faculty to create assignments they could not have created otherwise. This stage led to self-paced, self-directed learning, and adaptive content that adjusts to the learner's prior knowledge or skills gaps, using competency-based learning outcomes. Teachers were able to include educational technologies, such as simulations, games, virtual reality, and artificial intelligence engines to transform the way they instruct their students.

Researchers indicate that substitution and augmentation are the enhancement stage for the use of technology tools. When the use of technology reaches the modification and redefinition states, the impact is considered transformative. Online, virtual, or digital education is at the transformation stage, bringing about disruptive innovation in education.

For states to benefit from the advantages these tools can bring, they need to support the efforts of schools and teachers who are working to implement change and help them to foster state-wide scaling of their efforts.

5 Emerging Technologies



Factor the relevance and appropriate use of emerging technologies in strategic decision making and foster faculty professional development in these technologies to maximize their benefits to students.

Emerging Technologies

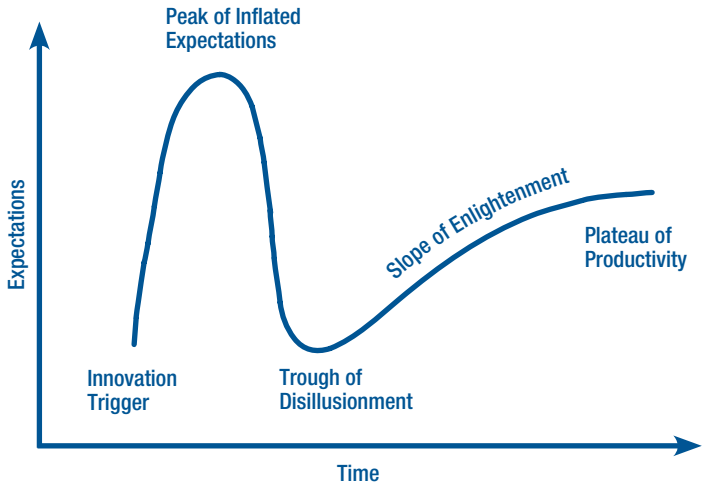
Education administrators are most concerned about instructional effectiveness —not with promoting the use of new tools for the sake of integrating technology into the classroom — and rightly so. Even if new tools are available, practical issues often impede the effective use of them, including: training to ensure teachers, principals/administrators and support staff know how to use the technologies; sufficient infrastructure and bandwidth to support the new instructional methods; policies that provide access and authorization; and technology teams that support instructional use while protecting privacy

and security of the students, employees, and institutional assets. Nevertheless, administrators, policies, and infrastructure should be flexible enough to experiment with emerging technologies so that students can make use of them to engage more deeply in their learning, to improve persistence and completion of degrees or diplomas and to prepare for the 21st century workforce.

Even teachers and administrators who want to embrace new technologies find it difficult to keep up with the ever-changing landscape. Technology changes so quickly that keeping up with emerging tech-nologies is nearly impossible, which is why some have substituted the term "bleeding edge" for what others have called the "leading edge." To help educators make sense of the types and uses of new technologies targeted for higher education, Eduventures mapped more than 600 technologies in 2017, showing their features and capabilities. Their intended use — business or industry or social — often predetermines which ones reach the mainstream. Tools designed for instructional use often lag behind those designed for business and industry. Cross-uses of tools from one sector to another is not uncommon.

Gartner, Inc. has developed a way of charting the cycle of technology trends that has proven helpful in putting emerging technologies into perspective. The Gartner Hype Cycle provides a way for business and education practitioners to stay abreast of technology trends and to project the path a new technology tool might take once it has been launched. Some, according to the cycle, will be short-lived, and some will be transformational. Gartner's Hype Cycle traces technology trends through five stages on one axis of time and another of expectations: the innovation trigger, the peak of inflated expectations, the trough of disillusionment, the slope of enlightenment, and the plateau of productivity. It helps sort out technology tools or systems and provides a timeline for likely adoption into the mainstream.

FIGURE 2: Gartner Hype Cycle



Source: Gartner, Inc. This graphic was published by Gartner, Inc. as part of a larger research document and should be evaluated in the context of the entire document. The Gartner document is available upon request from http://www.gartner.com/technology/research/methodologies/hype-cycle.jsp.

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Gartner's 2017 educational technology hype cycle places the emerging education technologies on this same timeline, allowing educational agencies the benefit of strategically planning for integration of the most productive and effective tools. It indicates the time it takes for education technology tools to reach mainstream adoption, up to 10 years. Some tools may be fads and fizzle immediately or become obsolete before they reach mainstream adoption. Education agencies that use the hype cycle, however, have a better chance of not implementing outmoded tools.

Schools teams should consider all aspects of how they will implement any new educational technology. Otherwise, they may find that what appeared to be a simple addition to their routines is really a daunting task that requires expertise beyond that of a typical teacher or principal. Some of these considerations include:

- comparing total cost of ownership, including infrastructure as well as equipment
- measuring classroom effectiveness of the tool
- vetting similar tools to determine the best one
- integrating the tools into teaching processes
- assuring privacy and security of devices
- providing for access to and protection of data generated by new tools
- planning for scalability and comprehensive implementation for widespread adoption
- assuring compatibility and interoperability of devices with existing systems
- planning an exit strategy in case the vendor leaves the market or improved technology becomes available, for example determining how to retrieve data or other intellectual property in a usable format or disentangling the tool from systems or processes
- supporting various apps, operating systems, and devices
- assuring vendor agrees to provide technical support to resolve problems if user determines that vendor's software or browser upgrades interfere with technologies customer previously adopted or cause unexpected errors that students or faculty cannot resolve
- ensuring accessibility for students with disabilities
- aligning technology use with student outcomes, and
- training for teachers, administrators, and support staff for effective use and evaluation.

Most emerging educational technology tools begin with a teaching purpose. But many of them find their way to the classroom from social, business or game applications. Consider social tools like Facebook, Twitter and Instagram which are now used in classroom instruction, but only after mainstream adoption by the general population.

Virtual worlds in 3D, such as Second Life, had a slow start in education because faculty and students found them difficult to learn, and research provided little evidence that they were effective in promoting learning outcomes. But tools such as Second Life, Minecraft, OpenSim, World of Warcraft, and Unity have now found their way into classrooms, because they help students build and create things within special learning applications. For example, health care workers in training can build virtual hospitals, and military personnel in training can build virtual battlefields, both groups preparing for missions with simulated experiences and scenarios they might encounter on the job. Recent publications by the International Society for Technology in Education (ISTE) and Government Technology indicate that virtual reality and gaming have the kind of positive "disruptive" effect on military training that Horn

described. The U.S. military uses such applications as training tools for soldiers to simulate dangerous situations without actually putting the soldiers in harm's way.

Heating, ventilation, air conditioning, and refrigeration (HVAC-R) businesses are using virtual reality headsets to train new employees. They employ senior technicians who can no longer endure the physical labor of the jobs, but who have extensive experience in HVAC-R. From a computer in an office, the senior technicians help the rookies troubleshoot jobs without having to climb ladders onto industrial rooftops or move large equipment. Instructors and administrators in traditional educational settings need to be aware that businesses are using these types of technology, so they can prepare their students for the work environments they will soon enter.

Integrating the emerging technologies into classroom instruction and curriculum is important. Many of the failed technology integrations have resulted from poorly planned implementation, failure to integrate technology tools into classroom teaching practices, or inadequate training in how to use the tools properly.

6 New Learning Models

Provide for more use of technology to create personalized, competency-based learning environments and delivery methods which allow students to demonstrate mastery of content at their own pace.

New and Old Learning Models

Few "new" learning models are entirely new, but new digital learning tools have revitalized many. Having students' diagnostic information readily available throughout the learning process can help teachers turn passive learning models into adaptive ones that are much more attuned to the individual student. Teachers can also use data mining, predictive analytics, or artificial intelligence to learn more quickly about their students' individual learning styles and gain insights into how to direct their learning paths. The data that learning management systems can gather and analyze about students throughout an online course can help faculty improve course design and teaching practices. Data dashboards provide teachers greater insight into student progress and specific struggles, so teachers can provide timely intervention. All of these advances require digital tools.

As teachers have brought several learning models together and added technology tools to support the models, they have been catalysts for education transformations. An example of this is personalized learning, which incorporates both competency-based and adaptive learning. Together they depend on sophisticated systems of diagnostic and formative assessment and adequate data systems to deliver assessment data to teachers systematically, so they can guide students toward individual paths for learning. Technology tools have changed competency-based education and adaptive learning — and have gone a long way toward creating a new way of conceptualizing personalized learning.

Key Definitions:

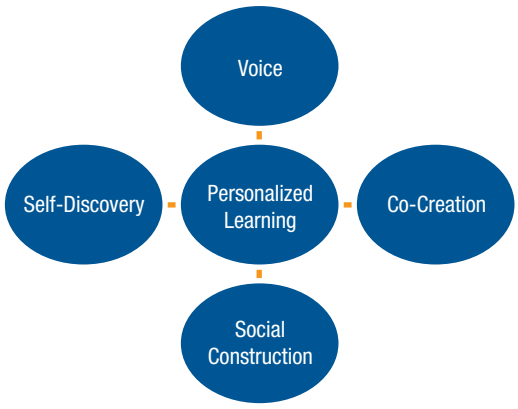
Competency-based learning
Students move through a course at their own pace as they master pre-determined competencies set for the courses. Course length is not defined by a calendar and credits are measured by competencies mastered, not by Carnegie units.

Adaptive learning
Learning is sequenced by technology tools that recognize when students have or have not met competencies and presents learning materials accordingly, stressing unlearned concepts as needed or moving ahead as permitted. It incorporates mastery learning because the student does not move forward until she/he has mastered the concepts, leaving no gaps in knowledge.

Just as competency-based education and adaptive learning can stand alone, so can other instructional elements that are sometimes incorporated into personalized learning. Project-based and service learning, which help students to apply knowledge to life situations, have been improved through use of technology tools, such as virtual reality, simulations and gaming. The flipped classroom — a blending of online and face-to-face instruction in which the traditional lecture or classroom presentation is placed online and the hands-on practice and experimentation are conducted in the classroom — is another example of how technology has led classroom redesign.

Personalized learning is not so different from other learning concepts such as differentiated learning and individualized learning. So, what's the difference? According to Bray and McClaskey, *differentiation* has been prevalent in education for many years in working with special groups of students, particularly in assessing needs and establishing learning programs. Individualization is student-centered instruction with individual assessment of learning, but is more directed by the teacher than the student. Personalized learning is more student-centered because the student's choice in learning activities and assessments fits her/his preferences, and the assessments that the students choose (such as projects, portfolios and videos) are part of the learning. Personalized Learning is self-directed, adaptive and mastery- and competency-based.

FIGURE 3: Professional Learing



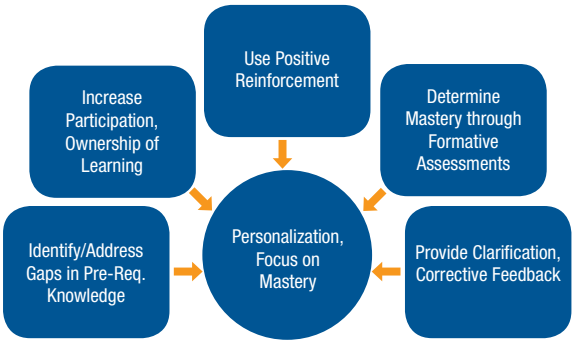
Ben Kallick and Allison Zmuda define personalized learning as a progressively student-driven model of education that empowers students to pursue aspirations, investigate problems, design solutions, chase curiosities, and create performances. In summing up its purpose, they identify four student concepts or habits of mind that characterize it: voice, co-creation, social construction and self-discovery.

It is easy to understand why some educators are so encouraged by the promise of personalized learning as a transformational model for education. It responds to a decades' old question posed by a noted educator. More than 30 years ago (1984), Benjamin Bloom posed the 2 Sigma Problem. He asked, "How could you replicate the results of one-to-one tutoring in a more cost-effective, scalable way?" In short, he was asking how to create near-perfect learning environments. Research at that time showed that one-to-one tutoring resulted in students outperforming 98 percent of their peers who were not tutored — learning that was two standard deviations above the mean. But individual tutoring is hard to scale.

One answer to Bloom's question was mastery learning, in which the pace and path of learning could be adjusted until the student mastered the concepts and then moved on to the next level. Mastery learning resulted in more than 1 Sigma return, or 1 standard deviation of student improvement. But further study showed that fostering five constructs together (identifying gaps in learning, improving ownership and participation, using positive reinforcement, determining mastery through formative assessments, and providing immediate corrective feedback) with a focus on mastery learning produced a 1.7 Sigma gain. (See Figure 4.) Students who received this type of instruction performed better than 96 percent of their peers who did not — even without individualized tutoring. And now, after more than 30 years, emerging technology makes the solution to Bloom's 2 Sigma Problem scalable in schools today.

Artificial intelligence also shows promising results for scaling one-to-one tutoring and making an impact on other student support services. A professor at Georgia Tech surprised his students when he revealed to them at the end of the semester the true identity of their online teaching assistant, Jill Watson. "She" was none other than IBM's Watson! Artificial intelligence has evolved to the point that students can submit natural language questions and receive responses from a robotic teaching assistant that are indistinguishable from the ones that other human teaching assistants send. This technology was around as early as 2011 when IBM's Watson won Jeopardy — and well before education adopted it. Now IBM is partnering with Pearson and Blackboard, two of the largest education companies in the marketplace, to integrate Watson into teaching and learning strategies. Pearson is embedding Watson into its system for student one-to-one tutoring to help students stay engaged and deepen their learning. Blackboard is using Watson to give teachers better insights into students' academic, social, and behavioral progress and to personalize their learning experiences. Artificial intelligence applications are adding to the ways that technology is helping to scale the solutions to Bloom's 2 Sigma problem.

FIGURE 4: Bloom's 2 Sigma Solution



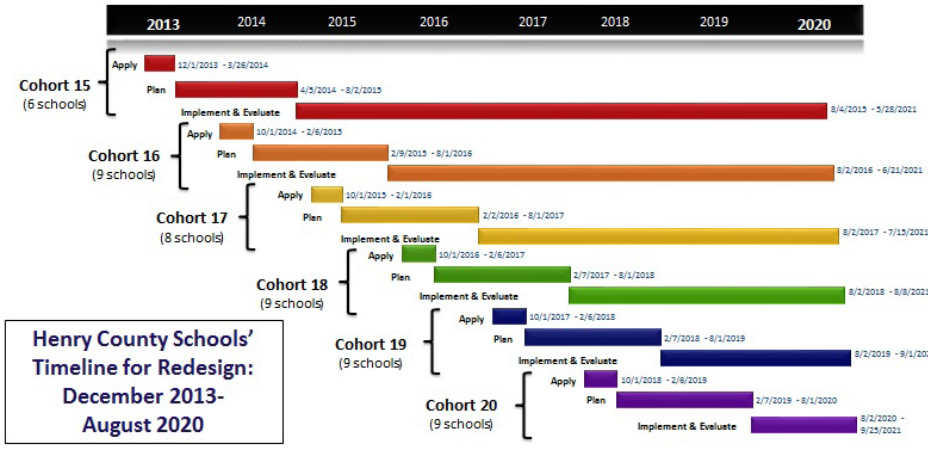
From Planning to Implementation

Several SREB states have implemented personalized learning initiatives, including Kentucky, North Carolina, South Carolina and Georgia; others are in the planning stages. Because personalized learning is such a complex learning model, states wishing to implement it need effective strategic planning to account for its multiple dimensions. They need to consider the student perspective, leadership capacity, professional development requirements, availability of high quality digital content, adequate assessments and a strong technology infrastructure. Plans also need the flexibility to change. When schools take on wholesale transformation, they typically take several years to reach a new equilibrium; in the meantime, the external environment will likely change in a variety of ways: regulatory changes are likely, such as accountability system changes; marketplace changes including vendors that enter or exit the market; evolving technology; and staff turnover. For programs to survive, they need flexibility, adaptability and thorough documentation.

Districts and schools taking on these complicated transformations need professional project management, particularly for large-scale, district-wide and tiered-approach implementation. This kind of *professional* management — in addition to all else — helps administrators learn from their mistakes and make the necessary corrections along the way. District-wide and state-wide initiatives require teamwork, stakeholder buy-in, regulations, policies and practices that are aligned with the tenets of the instructional innovations.

Secondary schools in Henry County Georgia have adopted personalized learning through a district-wide implementation, with a plan to encompass 50 schools by 2020. Henry County used tiered implementation, with eight or nine schools starting the process each year until the entire district uses the personalized learning model. The initial schools are already seeing improved persistence, and fewer disciplinary actions and absences. They also report increased enthusiasm by students who have

FIGURE 5: Henry County Schools Implementation Timeline



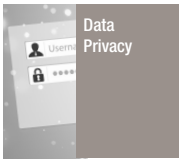
taken ownership of their learning, in large measure because they have — as they term it — "choice and voice" in the direction of their learning paths.

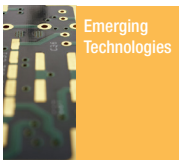
Transform South Carolina has implemented a competency-based, personalized learning model in 55 schools from 23 districts, including five districts in which all schools are involved in the program. These schools and districts — and ones in Henry County, Georgia, as well — have had to work around state agency policies and legislation that created barriers to implementation. Schools and districts requested exceptions to these policies and regulations, asked for special trial periods to test innovations, and sought innovation zone legislation to implement their program as proof of concept.

Higher education implementation of similar programs, typically competency-based education, generally requires exceptions and work-arounds as well. The Kentucky Technical and Community College System (KCTCS) learned how troublesome federal financial aid regulations can be when implementing pilots that are self-paced, competency-based, non-term, online programs, such as Direct to Degree (D2D) and Learn on Demand. KCTCS also learned that in addition to regulatory and policy hurdles, technology systems often require work-arounds and customizations to incorporate innovative practices into systems that were created for the Carnegie unit — not mastery of competencies. Technology vendors have not yet developed the flexible systems that would make these systems work compatibly. Currently technology infrastructures are not as adept at integrating new learning models and emerging technologies into the instructional and information systems as they might be to achieve the accountability and conformance with regulations and policies that institutions require. Many of these systems still focus on academic terms or total time of instruction.

Stakeholder Involvement

When states or districts decide to pursue advancements in education technology and want to adopt new learning models, they should not underestimate the importance of teamwork and stakeholder buy-in in their planning. In North Carolina, charges from three former governors led to legislation or innovative state-wide models for: a broadband educational network, a digital learning plan, the use of electronic textbooks and a requirement that all students take at least one online course. Work from diverse focus groups, commissions, and committees from educational agencies, business and industry helped to shape policies and practices and helped make digital learning a priority for the state.





For successful district, system, or state-level implementation, a cross-functional team is critical — one that represents various departments and the entire hierarchy of stakeholders. From top-level administrators who can advocate for funding and public support of the initiative, to IT support from a technology infrastructure and technical help-desk perspective, to teacher/professor buy-in and extensive training, to instructional designers and accessibility experts, to counseling and advising students — the broader the base of committed stakeholders, the better.

When establishing statewide teams, states should ensure that all stakeholders are included. Technology professionals should be key members of any such teams. Legislators and education professionals who serve on committees and commissions need input from technology professionals to prevent well-meaning policymakers and education leaders from making mistakes. Sometimes these mistakes result in new rules, mandates or legislation that complicate an already difficult transition to innovative instruction. In others they result in unnecessary expense. Some states, for example, have had to repeal or rewrite student privacy and technology security regulations written by statewide teams so they would be able to interpret and exchange data and meet basic reporting requirements. It is also important to hold conversations with educators at all levels — and not just hear from principals or district leaders — to find the right way forward.

Policies, Practices and Recommendations

Digital disruption is a positive driving force for educational transformation. But disruptive change requires adjustments to policies and practices. Schools, institutions, agencies or systems need to work through new processes and practices as they develop these new policies in the midst of transformation.

One key to success: schools and colleges need a process for vetting emerging technologies and new models, and for learning to implement them to improve educational outcomes. Organizations like EduVentures and Gartner, Inc. have provided insight on how educational technologies emerge, but schools or colleges need a support system for learning how to implement technology tools into classrooms effectively. The Virtual Learning Community® of the North Carolina Community College System, created in 1995, has three instructional support centers to assist its 58 colleges and their faculty with online and blended learning. The centers are hosted at three community colleges and are run by college staff with annual allocations from the system office. The Quality and Assessment Center develops online courses, assesses them for rigor, relevance, and accessibility, and reviews technology trends and tools for further research. The Technology Center then vets the chosen emerging technologies to determine the most effective use, assesses their hardware, software, or system requirements, and maintains a showcase of tutorials about the resources. The Professional Development Center conducts events, workshops, and webinars on all the technology tools, learning models, pedagogy, and regulatory guidelines such as digital accessibility or state authorization of distance learning. This model effort takes the burden off college faculty and staff, who would not likely have the resources for such a comprehensive approach, especially at small colleges. The maintenance phase of change requires significant resources and commitment to ensure that the change will last. Stakeholders must be committed beyond the start-up or implementation phase and provide resources to sustain the effort for continual improvement.

Another key to success is making technology decisions based on need. Purchasers should keep in mind the mantra: *Need should always be the driver in the decision to purchase.* Too often the latest glitzy or fad technology tools are difficult to resist. And often vendors are so convincing in their sales pitches that consumers buy products for which they have not clearly established a need. They might even find themselves trying to justify their purchases later or convince others of the utility of the products. Business or pedagogical need should always drive a technology adoption. If the need is to promote better student

engagement, longer persistence in school, and deeper learning, vendors should be able to show that their products can help produce those outcomes. Whether the goal is to help students achieve greater competency-based, mastery, or adaptive learning or to accelerate graduation while improving educational outcomes, the vendor should be able to show that the technology or application can deliver.

Conclusion

Technology changes at a more rapid pace than education reform. While educators may change to produce higher education outcomes, they are often averse to risks that could cost their states money and not produce results. Yet states must take some risks if they are to be rewarded with transformational change, especially in education.

Policymakers have to find a balance between evidence-based models of educational effectiveness and emerging technologies that hold promise for improved student learning, particularly in a digital world where tomorrow's jobs don't even exist yet. They are called on to make decisions that strike a balance between oversight, accountability and security on one hand and technology-enhanced innovations (driven by data collection) and a desire for greater student engagement on the other. Experts, and experience, tell us that learning does not happen in the same way or at the same pace for all students. Adaptive, self-paced, personalized and mastery-based learning can transform K-20 education — so long as it uses emerging technologies and systems that can scale these methods across districts, regions and states. After all, these types of student-centered approaches will help students take ownership of their learning, determine their own paths, and think creatively to help shape their future work environments. But the educational technology hype cycle tells us that some of today's emerging technologies will die quickly and offer students little help, while some can truly transform education. It takes teamwork to plan and implement technologies, learning models and assessments that can tell the difference, and make a difference.

This report was prepared by Wanda Barker, director, Educational Technology Cooperative, and Joan Lord, vice president for Education Data, Policy Research, and Programs. For more information, email Wanda.Barker@SREB.org.

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