



Education

Transforming Education for the Next Generation

A Practical Guide to Learning and Teaching with Technology



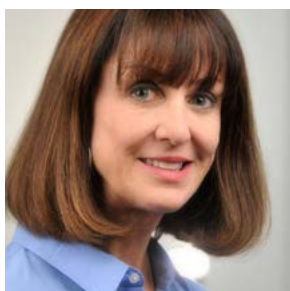
About This Guidebook

Around the world, digital technologies are demonstrating their ability to empower educators in their mission of developing the next generation of lifelong learners, innovators, and global citizens. With an effective technology foundation and the right support, teachers gain powerful tools to deepen, accelerate, and enhance student learning. Students can research, create, communicate, and collaborate in ways that better prepare them for the world, the workforce, or higher education. School systems can base critical planning decisions on a deep, evidence-based understanding of how to improve learning and teaching.

Educational technology initiatives also bring risks, however. Achieving the promise of technology requires more than simply deploying devices. If initiatives focus too much on technology and not enough on compelling usages that improve learning and teaching, the results will be disappointing. Transformative initiatives result from holistic efforts that bring about changes in professional learning, curricular planning, assessment and evaluation, policy frameworks, and more. Poorly planned initiatives can waste time and money, widen inequity, expose private data, reduce confidence in the education system, and delay the potential benefits. Even well-designed initiatives can fall apart if they depend on a single charismatic leader who moves on, or if funding evaporates.

In a time of limited resources and competing budget priorities, it's vitally important to ensure that investments in technology are successful and sustainable—and that they deliver the value they promise. This guidebook is designed to help. It describes a holistic model that starts from a vision of student success and addresses the broad range of elements needed to produce transformative change. Successful students will in turn drive economic development. This guidebook shares insights, perspectives, and practical strategies from education leaders and visionaries around the world, along with tips, tactics, and case studies drawn from Intel's work with teachers, education systems, and governments in over 100 countries.

I hope you'll apply this model as you conduct your educational technology and transformation initiative. Together, we can prepare students for their future.



Eileen M. Lento, Ph.D.

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Chapter 1 21st Century Education for Student Success and Economic Development



Chapter Introduction by Andreas Schleicher

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“It is critically important to attract good teachers, support and encourage their professionalism, continue to invest in them, and align assessment and rewards to support innovation in teaching.”

In a fast-changing, interconnected world, education must change to prepare students for success in life. The modern global economy doesn't pay you for what you know, because the Internet knows everything. The world economy pays you for what you can do with what you know.

Nations that want a knowledge economy are investing to produce students who can intelligently manage and evaluate information and data. They are moving beyond asking whether students can reproduce what they learned in school. They want to know how creatively they can use what they know, and whether they can extrapolate from it and apply their knowledge in another context. Skills such as critical thinking, creativity, problem solving, and collaboration are at an increasing premium.

Since the first Program for International Student Assessment (PISA) study in 2000, we have come a long way in stimulating discussions about how to improve student performance and equity. We see that successful nations and school systems set high expectations for all students. They embrace diversity, and provide a high degree of support for each student. They understand that students learn differently, and really engage with that. Modern learning can no longer be about a one-size-fits-all system but about personalizing learning approaches.

This requires a very different learning environment, a very different kind of work organization, and a very, very different caliber of teachers. It is critically important to attract good teachers, support and encourage their professionalism, continue to invest in them, and align assessment and rewards to support innovation in teaching.

Technology has to be an integral part of the process. Technology allows us to embrace teaching and assessment of entirely new skills that are very important for the 21st century and that you cannot develop in a kind of traditional environment. But technology has to work through teachers. Technology can leverage great teaching enormously. But great technology doesn't replace poor teaching. The challenge is to bring technology into the picture in ways that translate into good teaching and learning. This requires sophisticated public policy, a long-term commitment, and a systematic approach.

For school systems, the benchmark for success is no longer to be better than you were last year, but to measure up against the best performing systems in the world. The potential rewards are tremendous. Even modest improvements in student performance can produce hundreds of trillions of dollars over the lifetime of a cohort of students. Civic engagement and volunteerism also depend closely on the skills of citizens.

In today's global economy, the consequences for not making progress are increasingly consequential. In the past, if you had low levels of skills, you could still get a decent job with a decent wage. Today, that's no longer possible. You end up in a race to the bottom. The people at the high end of the skill distribution, on the other hand, have seen dramatically improved wages. The cost of low education performance is very, very high, and the consequences of inequalities in educational outcomes are dramatically widening.

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Andreas Schleicher

Andreas Schleicher is an education visionary, researcher, and statistician who chairs the OECD Program for International Student Assessment. He holds an M.S. in Mathematics from Deakin University, and was named an Honorary Professor in the Faculty of Behavioral and Cultural Studies by the University of Heidelberg.

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Starting from a Vision of Student Success

Learning-focused educational technology initiatives start from a clear vision of the intended goals and an understanding of how powerful mobile devices and other information and communication technology (ICT) can help schools achieve them. This chapter provides an overview of:

- What students need to thrive as next-generation citizens and innovators and achieve their full potential
- How student-centered models of learning help meet those needs
- How educational technologies can empower students and teachers for success
- Potential goals and impacts for transformative educational technology initiatives

Subsequent chapters present a holistic model to guide a learning-focused educational technology initiative, including best practices and examples of successful initiatives.

Thriving in a Changing World

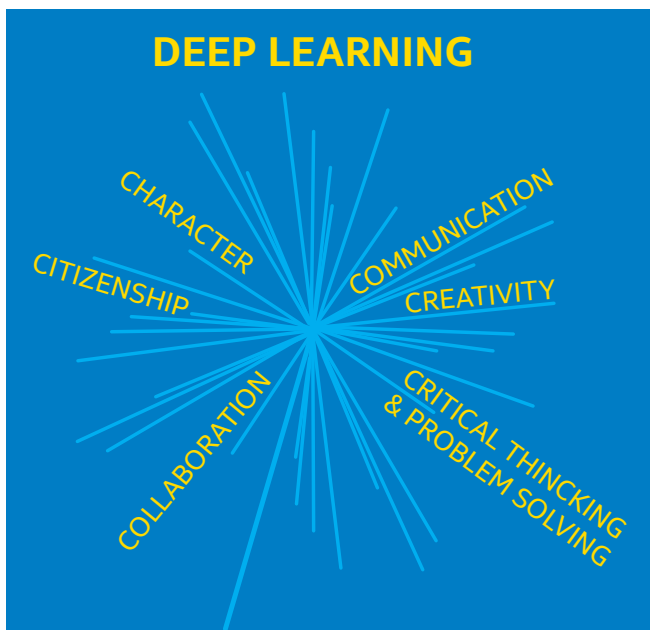
Today's students will live in a rapidly changing world with opportunities and challenges that are very different from the ones many of us grew up with. To fulfill their human potential and lead their communities and economies, students must not only master a foundation of facts and concepts, but also be able to apply, extend, and expand on that knowledge. They must develop 21st century, transversal skills that enable them to:

- Work independently as self-driven, life-long learners and innovators
- Work collaboratively and respect diverse viewpoints
- Think critically about new challenges
- Apply their knowledge in novel situations to solve new problems
- Communicate via a range of technologies and methods
- Work persistently in the face of difficult challenges

In addition to raising achievement, policymakers increasingly recognize that they have a moral as well as a practical imperative to increase equity and improve success for all students. In a closely connected, knowledge-driven world, each school, community, state, municipality, province, and nation benefits by raising student outcomes for every learner—and no society can excel if it writes off a large part of its populace.

The New Pedagogies for Deep Learning Global Partnership, a consortium founded by Intel and other organizations committed to equipping students for success, offers a framework that aligns with these goals and requirements. Writing for the partnership, Michael Fullan and Maria Langworthy emphasize the need to “prepare all learners to be life-long, creative, connected and collaborative problem solvers and to be healthy, happy individuals who contribute to the common good in today’s globally interdependent world. We need our learning systems to encourage youth to develop their own visions about what it means to connect and flourish in their constantly emerging world, and equip them with the skills to pursue those visions.”¹ In *Great to Excellent*, Fullan highlights six skills that provide a foundation for deep learning for every student²:

- **Character education.** Personal traits and attributes such as responsibility, perseverance, and empathy
- **Citizenship.** Knowledge of global issues, respect for other cultures, involvement in sustaining humanity and the environment
- **Communication.** The ability to communicate effectively and actively listen to others
- **Critical thinking and problem solving.** The ability to think critically to solve problems, make effective decisions, and design and manage projects
- **Collaboration.** The ability to work in teams, learn from and contribute to others’ learning, and collaborate with diverse individuals
- **Creativity and imagination.** The ability to consider and pursue novel ideas, lead others, undertake economic and social entrepreneurial activities



Transforming Schools to Match 21st Century Needs

How can schools, parents, and societies empower students to develop these skills and abilities? While the details of the answers may vary depending on local requirements, there is broad agreement that yesterday's lecture-centric, one-size-fits-all approach cannot prepare students for today's challenges, let alone those that will emerge in their lifetimes.

Instead, the traditional model, which developed out of the factory-era framework of the 19th century, is shifting to a modern model of personalized, student-centered learning. This new model reflects the needs and circumstances of 21st century students and societies. It encompasses the new science of learning and learning

styles, and takes advantage of all that ICT can contribute to learning and teaching—from mobile devices for students and teachers, to adaptive curriculum resources that give students and teachers instant information on the learner's progress. The student-centric model better empowers all learners to reach their fullest potential. It positions students and their societies to thrive in a knowledge-based global economy and a complex world.

OECD refers to successful learner-centric schools as innovative learning environments, and says they share seven important traits.³ Innovative learning environments:

1. Make learning and engagement central
2. Ensure that learning is social and often collaborative
3. Are attuned to learner motivations and emotions
4. Are acutely sensitive to individual differences
5. Are demanding for all learners but without excessive overload
6. Use assessments consistent with learning aims, with a strong emphasis on formative feedback
7. Promote connectedness across subjects and subjects, in and out of school

Teachers and Technology

ICT is a direct and profound enabler for transformed learning environments—but teachers, and the deep personal relationships they create with their students, remain the foundation for learning. However, teachers take on new roles as facilitators and guides who activate each student's unique learning path. Supported by effective policies, professional development, and digital curriculum, teachers gain unprecedented tools and information to customize the student's learning experience and deliver an academically rigorous education that emphasizes inquiry, investigation, independent learning, and collaboration.

Guided by highly skilled teachers, students in a transformed environment use powerful mobile devices as personal learning platforms. Accessing a wealth of digital learning resources and following modern pedagogic strategies, students can:

- Manage their time and take more control of their learning
- Engage with the world and access different mediums for learning in ways that fit their individual needs, excite their passions, and improve outcomes
- Explore and analyze vibrant, interactive learning resources throughout the school day and beyond
- Interact with materials that bring abstract concepts to life and tailor the presentation of content to each learner's needs
- Use a wide range of creative methods to demonstrate what they're learning
- Create and publish unique content, taking ownership of their ideas and engaging in meaningful social learning

In addition to direct support for student learning, ICT provides valuable tools and data for creating a more transparent, evidence-based culture. Teachers can use data from formative assessments to identify learning problems and intervene in real time to optimize outcomes. School performance management systems, human capital management systems, and other solutions provide a firmer basis to identify effective strategies and make evidence-based decisions on resource allocation and program management. ICT also provides cost-effective tools to help increase collaboration, and build trust and community through transparent communications.

As it has in other areas of the economy and society, ICT in education can increase efficiency and provide new ways to work. Teachers can reduce isolation and share best practices through online communities of practices and self-paced professional learning. Digital tools can offer efficient ways to organize and manage courses, content, assessments, grades, and other data. Digital learning resources can reduce the costs of textbooks while offering access to more timely content.

UNESCO is one of many organizations that recognizes ICT and teachers as central to education reform, economic growth, and social development. The UNESCO ICT Competency Framework for Teachers (ICT-CFT) identifies six important areas where education must advance in order to create knowledge-based societies that can reduce poverty and inequity, advance standards of living, and prepare students for the challenges of the 21st century. The UNESCO framework (Table 1.1) envisions ICT-enabled education transformation as a process that moves through three stages:

- Technology literacy: Students use ICT to learn more efficiently
- Knowledge deepening: Students use ICT to apply their knowledge to complex, real-world problems
- Knowledge creation: Students and their societies “create the new knowledge required for more harmonious, fulfilling and prosperous societies”⁴

Evolving Education to Create a Knowledge Economy: The UNESCO ICT Competency Framework

	Technology Literacy	Knowledge Deepening	Knowledge Creation
Understanding ICT in Education	Policy awareness	Policy understanding	Policy innovation
Curriculum and Assessment	Basic knowledge	Knowledge application	Knowledge society skills
Pedagogy	Integrate technology	Complex problem solving	Self management
ICT	Basic tools	Complex tools	Pervasive tools
Organization and Administration	Standard classroom	Collaborative groups	Learning organizations
Teacher Professional Literacy	Digital literacy	Manage and guide	Teacher as model learner

Table 1-1

OECD recognizes digital resources and platforms as essential enablers for innovative learning environments. OECD says ICT can help teachers transform the learning environment by⁵:

- Engaging learners and facilitating student-directed learning
- Facilitating collaboration and joint learning
- Facilitating differentiated and personalized learning
- Bringing in excluded learners or connecting learners who would otherwise not be included
- Redefining “educators,” enabling online tutors, experts, or teachers from other schools to serve as teachers
- Opening access to content resources that were previously unavailable
- Supporting virtual learning spaces and eliminating the idea that education occurs at a set time and place with a fixed set of students
- Building distributed leadership and transparency through ICT-based communication and collaboration
- Improving teacher learning through online materials, collaborative learning communities, and social media
- Building capacity through partnerships

Establishing Goals: What Can We Achieve?

Governments and educators at every level are investing in education transformation and educational technology to enhance innovation, advance a knowledge economy, reduce poverty, and increase equity.⁶ They are seeking results that can include a growing economy, rising standard of living, expanding tax base, and more active citizens. The European Union has established long-term strategic objectives for education policies⁷:

- Make lifelong learning and mobility a reality
- Improve the quality and efficiency of education
- Promote equity, social cohesion, and active citizenship
- Enhance creativity, innovation, and entrepreneurship

Learning-focused educational technology initiatives can produce impacts that support these goals and extend well beyond higher test scores. Establishing clear goals early in the initiative is an essential step toward creating an educational technology initiative that will achieve important objectives. The following are examples of goals that may be relevant to your initiative. Chapter 3 provides additional information on goal setting, and Chapter 9 discusses evidence-based ways to determine how well your initiative achieves its goals.

Achievement

- Raise levels of achievement on standards-based assessments, particularly in reading and in science, technology, engineering, mathematics (STEM), and other areas that are critical to economic progress
- Enable students to demonstrate higher levels of critical thinking, analysis, communication, and other 21st century, transversal skills
- Increase graduation rates

Equity

- Offer more equitable access to high-quality resources across regions and genders
- Increase the number of girls enrolled in school
- Increase the number of girls taking STEM classes
- Bridge the digital divide and provide equal access to technology across socio-economic barriers
- Reduce the achievement gaps between highest and lowest performing students

School culture

- Increase levels of student engagement
- Increase attendance
- Reduce behavior problems
- Improve communication and collaboration with parents
- Increase teacher satisfaction

Societal impact

- Increase alignment with workforce needs, including an increase in entrepreneurial skills and skills that drive innovation and new job development for the knowledge economy
- Increase female participation and achievement in society
- Increase active citizenship and lifelong learning
- Foster cross-cultural understanding

Large-Scale Impacts

Achieving the goals of a transformative educational technology initiative can help advance both individual and national success. Analysis sponsored by OECD⁸ shows that even small increases in student achievement can have large-scale, long-term economic impacts. Conducting economic modeling and using PISA scores as a measure of cognitive skills, the OECD-sponsored study found that raising the PISA scores of students in OECD nations by 25 points could increase the aggregate gross domestic product (GDP) of OECD nations of USD 115 trillion over the lifetime of the children born in 2010. Bringing all students in OECD nations up to a minimum skill level of 400 PISA points could generate aggregate GDP increases of nearly USD 200 trillion.

Successful educational technology initiatives can also help expand graduates' employment opportunities, counteract high rates of youth unemployment, and meet the rising need for advanced skills. By 2020, 20 percent more jobs will require higher level skills, according to the European Commission. The EC's report, *Rethinking Education*, calls for modernizing education in ways that provide greater flexibility and take advantage of ICT: "Education and training can only contribute to growth and job-creation if learning is focused on the knowledge, skills, and competencies to be acquired by students (learning outcomes) through the learning process, rather than on completing a specific stage or on time spent in school. ...The digital revolution brings important opportunities for education. It is time to scale up the use of ICT in teaching and learning."⁹



CASE STUDY

Holistic, Policy-Based Approaches to Education Transformation in Peru and Panama

Educational technology initiatives are an effective way to support and extend broader efforts to increase economic development.

The **regional government of Callao, Peru**, is investing in educational technology as part of a broader program to establish Callao as a digital city. Peru's leading port city, Callao uses ICT, including a wireless metropolitan network, to improve learning and teaching, as well as to enhance citizen access to government, healthcare, higher education, police and fire stations, and other services. Peru is providing mobile devices and learning resources, establishing in-school infrastructure, and delivering professional learning to nearly 30,000 educators. Among the innovative aspects of the Callao initiative, an EduCallao educational portal is open to the general public and offers access to thousands of learning resources—from a free online tutorial on ICT basics, to virtual courses.

The **Republic of Panama** is taking a comprehensive approach to transforming digital literacy and economic development through its Balboa Project, a nationwide rollout of digital learning resources in 728 schools. Panama's Ministry of Education is deploying mobile devices and network infrastructure and establishing services to enhance teachers' professional development in the use of ICT for learning and teaching. The Balboa Project began with the approval of a national government initiative whose goals include:

- Contribute to greater educational equity among students
- Improve digital literacy
- Provide students with computers for daily use in the development of their schoolwork
- Expand the opportunities for students to access information
- Contribute directly to local household economies



Nationwide ICT
integration
in 728 schools



179,000 PCs
distributed



162 early education
centers equipped
with ICT

Citations

- 1 Michael Fullan and Maria Langworthy, *Towards a New End: New Pedagogies for Deep Learning*, Collaborative Impact, 2013. http://www.newpedagogies.info/wp-content/uploads/2014/01/New_Pedagogies_for_Deep%20Learning_Whitepaper.pdf
- 2 Michael Fullan, *Great to Excellent: Launching the Next Stage of Ontario's Education Agenda*, 2013. http://www.michaelfullan.ca/wp-content/uploads/2013/09/13_Fullan_Great-to-Excellent.pdf
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- 4 UNESCO ICT Competency Framework for Teachers Version 2.0, 2011. <http://www.unesco.org/new/en/unesco/themes/icts/teacher-education/unesco-ict-competency-framework-for-teachers/>
- 5 OECD, *Innovative Learning Environments*, Chapter 8: Creating and Sustaining Innovative Learning.
- 6 See UN System Task Team on the Post-2015 UN Development Agenda: *Education and Skills for Inclusive and Sustainable Development Beyond 2015*, Thematic Think Piece, May 2012. http://www.un.org/millenniumgoals/pdf/Think%20Pieces/4_education.pdf
- 7 See *Europa Summaries of EU Legislation, Education and Training 2020*. http://europa.eu/legislation_summaries/education_training_youth/general_framework/ef0016_en.htm
- 8 OECD: Programme for International Student Assessment. *The High Cost of Low Educational Performance: The Long-Run Economic Impact of Improving PISA Outcomes*, 2010. <http://www.oecd.org/pisa/44417824.pdf>
- 9 European Commission, *Rethinking Education: Investing in Skills for Better Socio-Economic Outcomes*, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions, 2012.

Resources

- Project RED provides a wide range of resources and research reports for school leaders. See *The Technology Factor: Nine Keys to Student Achievement and Cost-Effectiveness*, MDR 2010, at <http://www.pearsonfoundation.org/great-learning/research-reports-and-surveys/project-red-the-technology-factor.html>. Additional resources are at: <http://www.projectred.org/>
- Robert J. Marzano, Timothy Waters, Brian A. McNulty; *School Leadership that Works: From Research to Results*, ASCD and McREL, 2005
- New Pedagogies for Deep Learning. <http://www.newpedagogies.info/>
- OECD: The High Cost of Low Education Performance, 2010. http://www.oecd-ilibrary.org/education/the-high-cost-of-low-educational-performance_9789264077485-en
- OECD Innovative Learning Environments Project: <http://www.oecd.org/edu/ceri/innovativelearningenvironments.htm>
- OECD provides comparable data on education strategies and results around the world: <http://gpseducation.oecd.org/Home>
- UNESCO ICT Competency Framework for Teachers Version 2.0, 2011, and other resources: <http://www.unesco.org/new/en/unesco/themes/icts/teacher-education/unesco-ict-competency-framework-for-teachers/>

Chapter 2 Building Success with a Holistic Model



Chapter Introduction by Michael Golden, Ed.D.

Chief Executive Officer
Educurious
@Educurious

“We want to capture students’ imagination and interest, help them take ownership of their learning, and enable them to learn in meaningful ways.”

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There’s widespread agreement among forward-looking educators about what we want for our students. We want to set high expectations and support all students to meet those expectations. We want to capture students’ imagination and interest, help them take ownership of their learning, and enable them to learn in meaningful ways. We want them to develop all the skills they need for success, including 21st century skills such as critical thinking and problem solving, and non-cognitive skills like tenacity, grit, and persistence. Technology is a powerful enabler, but many of the results to date have been lackluster. I believe part of the explanation lies in focusing on technology for its own sake, and failing to grasp how much system change is required to be successful.

Schools are complex systems. To make sustainable progress, we have to incorporate digital technologies and curriculum in ways that change what happens in the classroom every day. This means approaching technology deployment not as a device initiative, but an education initiative. It means focusing on student learning and making changes across the educational system. We start by asking: What learning outcomes are we after? And then: Where and how can technology help us make that happen, especially in ways that it never could before, by facilitating new interactions and new supports?

We've seen enough successful initiatives to know that this requires a comprehensive approach and effective change management across the education system. It takes modern policies and strong leadership at every level to bring stakeholders together and develop a strategic plan that is both visionary and practical. It calls for effective technologies and support systems, and sustainable funding to make sure programs can continue to advance. Above all, it requires empowering teachers through ongoing professional development to work with new resources, approaches, and content and change what happens in the classroom.

It's hard work. There is no silver bullet. But this is a perfect time to be making these changes. Budget constraints are pushing us all to think about sustainability and scale in different ways. We're seeing an explosion of digital resources, and the best ones are built on the science of how and why people learn.

We're identifying what works. Now we need to share and scale our successes. By taking a systems approach with student learning as the goal, we can move closer to success for every student.

Michael Golden

As CEO at Educurious, Michael Golden is working to transform the global K-12 learning experience in ways that create curious, motivated young people who are ready for college and careers. Michael served as deputy secretary with the Pennsylvania Department of Education, and previously held executive positions at Microsoft and Pearson Education. He earned a Doctorate in Education Leadership from the University of Pennsylvania and an MBA from Harvard University.

Driving Deep Change

While ICT can be useful in targeted, small-scale scenarios, the greatest educational impact occurs when schools embed ICT within a comprehensive initiative focused on student success. In addition to equipping students and teachers with mobile devices, those involved in an educational technology initiative must also:

- Envision new ways of learning and teaching that prepare students for 21st century success
- Align policies, curriculum standards, assessment, teaching strategies, and professional learning to support the full and effective use of digital platforms and resources
- Lead and manage complex changes throughout the system
- Develop sustainable resources to ensure long-term viability
- Evaluate the initiative's success, build understanding of the changes, and push for further improvements

These tasks are challenging and interconnected, requiring strong collaboration among multiple stakeholders. Yet all are necessary, and a failure in any area can weaken the educational impact of the initiative. Success requires ongoing, long-term effort aimed at new goals, new approaches, and new ways of thinking about problems and opportunities. It embodies what scholars characterize as second-order change (Table 2-1). But the rewards can be significant. Project RED's groundbreaking research found that well-implemented K-12 educational technology initiatives can improve student performance by double or more.¹⁰

Planning for Deep Impact: First-Order versus Second-Order Change ¹¹

First-Order Change	Second-Order Change
Extends what has been done in the past	Represents a break with the past, doing things in a dramatically different ways
Keeps the same basic goals and organizational structure	Shifts from teacher-centric, one-size-fits-all pedagogy to student-centric learning environments
Focuses on doing the same things better	Establishes new goals, such as developing 21st century skills and activating a personalized learning path for each student
Maintains a teacher-centric, one-size-fits-all model	Empowers teachers to work as guides and facilitators in a student-centered learning environment
Uses ICT to implement traditional pedagogy, such as drilling on math problems or vocabulary words, replacing physical textbooks with PDFs, or doing computer-based scoring of multiple-choice tests	Incorporates ICT into student-centered learning strategies and advanced assessments, such as students using educational gaming or interactive simulations to analyze and respond to a virtual chemical reaction, earthquake, epidemic, or other event; or using ICT for project-based learning, problem solving, and collaborative research

Table 2-1

A Proven, Holistic Model to Build Success

Intel's Education Transformation Model facilitates second-order change for K-12 educational technology initiatives. Grounded in research, this model provides a holistic framework that encompasses the seven essential elements shown in Figure 2-1 and summarized in Tables 2-2 and 2-3.

Intel's Education Transformation Model reflects evidence-based best practices that have emerged from Intel's collaborations with school systems and governments in more than 100 countries to advance their visions of education transformation. Using this model, stakeholders can address the practicalities of deep, large-scale, long-term change with ICT, to create sustainable improvements in student learning. Table 2-2 summarizes some of the essential tasks for each area of the model, and this guidebook discusses them in greater detail.

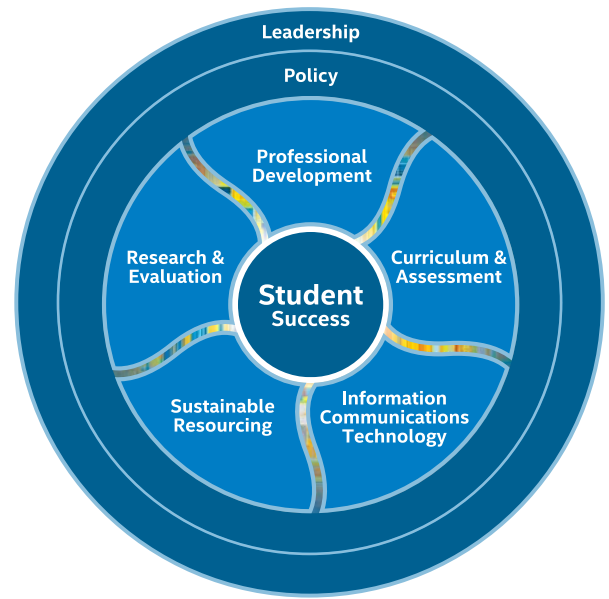


Figure 2-1. Intel® Education Transformation Model

Holistic Approach to Transformation: Summary of Essential Tasks for School Leaders

Aspects of Transformation	Essential Tasks
Leadership	<ul style="list-style-type: none"> Lead stakeholders in defining a vision of success Work from that vision toward a common understanding of why you're acquiring technology and how you will use it as a platform for learning Develop and execute a flexible yet detailed plan to manage change across all parts of the system and all areas of the transformation model Build leadership skills throughout the school system Promote innovation and accountability
Policy	<ul style="list-style-type: none"> Establish or modify the policy framework to support the fullest use of educational technology while maintaining security and privacy
Professional learning	<ul style="list-style-type: none"> Empower teachers through ongoing professional development to modify their teaching practice and use ICT in ways that significantly improve learning outcomes
Curriculum and assessment	<ul style="list-style-type: none"> Modify curriculum, pedagogy, and content resources to reflect next-generation learning objectives and incorporate ICT as a tool for learning Align curriculum and assessment to support next-generation learning and improve instruction through real-time, technology-enabled assessments
ICT	<ul style="list-style-type: none"> Identify where and how you will use ICT to improve student learning, increase equity, and achieve other goals Select devices that will support curriculum and assessment requirements Upgrade infrastructure and staffing so you can manage and secure the environment and maintain data privacy
Sustainable resourcing	<ul style="list-style-type: none"> Ensure that ongoing resources are available to support all aspects of transformation, including curriculum modernization, content resources, professional development, ICT deployment, etc.
Research and evaluation	<ul style="list-style-type: none"> Develop a framework to evaluate the program's effectiveness, identify evidence-based best practices, and create a cycle of continuous improvement

Table 2-2

While each education transformation initiative has a unique starting point and vision of success, transformed environments share many common characteristics (Table 2-3). In the case study, *Comprehensive Planning for a Teaching and Learning Initiative*, the technology director of a large United States school district discusses the importance of a holistic approach to implementing educational technology.

What Transformation Looks Like: Common Elements of a Transformed Environment

Aspects of Transformation	Characteristics of a Next-Generation Learning Environment
Student success	<ul style="list-style-type: none"> Students gain the skills, attitudes, and characteristics to fulfill their human potential and create a culture of 21st century prosperity, innovation, and citizenship Students have equitable access to educational resources
Leadership	<ul style="list-style-type: none"> A broad range of stakeholders engage in planning and supporting long-term systemic change Goals are clearly defined before technology rollout begins Distributed leadership builds capacity throughout the system Leaders inspire a school culture of innovation, accountability, collaboration, and support Leaders model skillful and enthusiastic use of technology
Policy	<ul style="list-style-type: none"> School, district, and state/national policies align to facilitate innovation, accountability, and the development of 21st century skills Practical policies support effective use of technology for learning and teaching Policies maintain the confidentiality of student and family data
Professional learning	<ul style="list-style-type: none"> Teachers have time for meaningful professional learning, curriculum development, and lesson planning Teachers and principals use a range of self-directed, ongoing professional development resources to adopt new learning and teaching strategies, build their capacity to design and deliver personalized learning experiences, integrate technology into all aspects of curriculum, and use data to improve student outcomes Technology instruction is integrated within professional development for curriculum and pedagogy Collaborative, supportive environment includes mentors, coaches, communities of practices, and growth opportunities for teachers
Curriculum and assessment	<ul style="list-style-type: none"> Modern curriculum standards ensure students gain the skills and knowledge to succeed Teachers use digital content, tools, resources, and platforms throughout the curriculum to deliver personalized, student-centered, inquiry-based learning and develop students' 21st century (transversal) skills Curriculum standards are aligned with assessments, and both align with modern educational objectives Assessments are conducted online and include formative and summative methods
Information and communication technology (ICT)	<ul style="list-style-type: none"> Ubiquitous technology supports educational objectives. Students and teachers use a range of mobile devices, ideally one device or more per person Devices are matched to the student's age, and the curricular and assessment requirements. Devices also meet requirements for security and remote management Networks provide ubiquitous wireless coverage without bottlenecks Schools, parents, and communities collaborate to extend wireless access beyond the school
Sustainable resourcing	<ul style="list-style-type: none"> The state's, province's, or school system's budget recognizes ICT as essential to learning and teaching and ensures sustainable, long-term funding The technology budget addresses all device costs, including the impact of device choices on issues such as software licenses, access points, and total cost of ownership.
Research and evaluation	<ul style="list-style-type: none"> The initiative starts from evidence-based practices for educational technology, and conducts valid research and evaluation to assess results Program goals and research questions are clearly defined, with metrics identified during program planning Results are reported to stakeholders and used to address any identified issues and create a cycle of continuous improvement

Table 2-3

CASE STUDY

Comprehensive Planning for a Teaching and Learning Initiative

By Debbie Rice, Technology Director, Auburn City Schools, Auburn, Alabama, U.S.A.
@debbiebrice

Auburn City Schools is a high-achieving district of 8,000 students in a diverse community in the American South. We have incorporated technology throughout our schools, including a one-to-one program for the 1,200 eighth and ninth graders of Auburn Junior High School. Over the eight years that we've run this initiative, we have seen a great change in how teachers teach at the junior high school. You can see it when you walk into the classroom. Kids are noisy but on task. They're working individually or in small groups, not sitting in rows of desks. Teachers say they would never want to go back.

Our experience shows us that technology initiatives require a comprehensive approach. You have to have all the components in place before you start putting devices into the students' hands. Professional development and infrastructure are hugely important. If you're putting computers in schools but you haven't provided professional development, you haven't given teachers time to think through how they're going to incorporate the technology into their lesson plans, and you haven't planned out your infrastructure, your efforts are going to be in vain. We gave our teachers their devices a full year before students got theirs, so they had plenty of time for professional development and curriculum planning. We continue to provide professional development, but the technology aspects are merged into curriculum planning and resource sharing, with new ways to do things and new resources online rather than technology itself.

Funding is always a concern. You need a detailed budget. We choose devices depending on the age of the student and the academic needs, but we scrutinize costs carefully. Some devices need more access points than others, or their battery life is significantly shorter, or their licensing and apps costs are huge. You need to know that up front, so you can decide if you want to invest in device performance or in things like access points and batteries.



8,000 students in a diverse American community



1:1 program for 1,200 8th & 9th graders



Teachers have **changed** how they teach—they won't go back



Whether you provide devices or have students bring their own, you need detailed planning for all aspects of the technology. Make sure you've got your filtering solution and network in place before students get their devices. Pay attention to the details. Do you have enough electrical capacity? Do you need more charging devices or electrical outlets? Will you be able to get stylus replacements? Those small details add up, and they affect your success.

You need careful change management. You're always going to have issues. Be prepared to work through them, and think openly about them. Develop a detailed plan, but be flexible. It has to be a living plan. And you've got to involve your stakeholders. Bring everybody on board. Leadership needs to be respectful. You can't just push change down on people.



"Develop a detailed plan, but be flexible. It has to be a living plan. And you've got to involve your stakeholders. Bring everybody on board. Leadership needs to be respectful."

Debbie B. Rice has helped lead Auburn City School's successful integration and use of educational technologies for nearly a decade. She is a sought-after speaker, valued for her clear vision, deep experience, and practical insights. She holds a B.S. in Accounting and Finance from Auburn University.

Citations

- 10 T. Greaves, J. Hayes, L. Wilson, M. Gielniak, and R. Peterson. *The Technology Factor: Nine Keys to Student Achievement and Cost-Effectiveness*, MDR 2010. <http://www.pearsonfoundation.org/great-learning/research-reports-and-surveys/project-red-the-technology-factor.html>.
- 11 Summarized and extended from Robert J. Marzano, Timothy Waters, Brian A. McNulty; *School Leadership that Works: From Research to Results*, ASCD and McREL, 2005 and *The Technology Factor: Nine Keys to Student Achievement and Cost-Effectiveness*, MDR 2010.

Resources

- Learn more about the Intel Education Transformation Model: <http://www.intel.com/content/www/us/en/education/education-transformation.html>
- Review research reports from education transformation programs around the world: <http://www.intel.com/content/www/us/en/education/evaluations.html>

Chapter 3 Leadership: Guiding Systemic Change



Chapter Introduction by Leslie Wilson

Chief Executive Officer, One-to-One Institute
President, Nexus Academy, Lansing, Michigan, U.S.
[@leslieawilson](#)

“This is hard, courageous work, and it takes time and patience. We have to leave our egos at the door and become change agents so we can better serve every learner.”

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Educational technology initiatives are about enabling students to achieve their greatest potential. As leaders, our job is to ensure that all the elements of the system line up to make that happen. This requires changes throughout the system—improving our curriculum resources and professional development, finding sustainable funding, creating policies that support it, and then creating a continuous cycle of innovation and improvement.

This is hard, courageous work, and it takes time and patience. We have to leave our egos at the door and become change agents so we can better serve every learner. We change the environment and work through the challenges by keeping the focus on serving every learner the best we can.

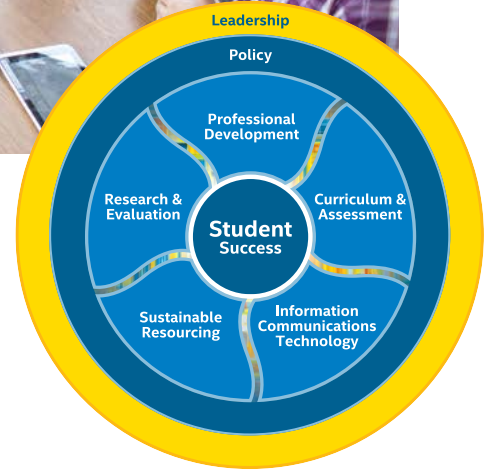
Leadership matters tremendously, both to bring stakeholders together and to manage these deep, systemic changes. All perspectives must be counted and part of this process. At the same time, we have to keep moving forward to serve learners. For the people who don't believe reform is needed, show them the research and data. Are we producing deep thinkers, problem-solvers, innovators, scientists, and engineers at the rate we need? Are children becoming less creative as they age in school? Are they dropping out at higher rates? Are students motivated in their learning environments? Examine the data, and figure out what it's telling us we need to do.

In the places where we see success with education transformation, we see consistent leadership and a systemic approach. The top leadership, policymakers, and teacher leaders share a common vision, and are working together to make changes happen throughout the system. It's not a matter of a single leader, but a leadership team that is banded together top-down and bottom-up around the strategic vision. The messaging and the expectations are consistent. Everyone understands the vision, the strategies, and the actions that need to happen—and they're all aimed at serving each student, so each one can reach his and her greatest potential.

The exciting thing is that changes are happening. Attitudes are changing. People recognize that even though money is tight and change is hard, we have to move forward. There's also much greater recognition that just putting the technology out there and waiting for magic to happen doesn't work. But we've got comprehensive transformation models, research to back it up, and expert practitioners who can help. Effective leadership teamed with a systematic approach can make it happen.

Leslie Wilson

Leslie Wilson has been in education for 41 years, including 31 years as a teacher, principal, and executive director at the district level. She is a co-author of Project RED, groundbreaking research around the impact of education technologies on student achievement and schools' budgets. Leslie led Michigan's successful one-to-one initiative. Leslie co-founded the One-to-One Institute, a nonprofit organization that assists school systems in developing learning environments that meaningfully integrate technology. At Nexus Academy, she leads a public academy of choice school that uses blended learning and one-to-one technology to activate a unique learning path for each student. She completed her undergraduate and doctoral coursework at the University of Michigan, has an MA in Instructional Technology from Wayne State University, and Special Education Administrator Certification from Eastern Michigan University.



Leadership Skills for Transformational Change

Transformative use of educational technology requires changes to pedagogy, curriculum, assessment, policy, ICT, funding, and more. Managing these changes calls for highly skilled leaders who can:

- Inspire strong-minded individuals with widely differing viewpoints to work together toward a common purpose
- Implement significant changes across a complex system that includes disconnected silos and diverse stakeholders
- Advance the school culture to increase collaboration, inspire innovation, and establish a cycle of continuous improvement

Second-order, transformational change demands a broader set of leadership skills than first-order change. In addition to managerial and administrative skills, school leaders who want to deliver the full value of ICT investments must offer strong curriculum leadership. Analysis by Robert Marzano and his colleagues indicates that second-order change in education requires that leaders¹²:

- Understand the research and theory behind the proposed changes and communicate it persuasively to teachers and other stakeholders
- Inspire confidence that the proposed changes can produce great results—that they're worth the effort
- Understand how proposed changes will affect curriculum, instruction, and assessment, and lead in implementing the changes
- Monitor results and make adjustments as needed to continuously improve the program's results

Leadership is crucial to ensure that technology-enabled learning becomes a permanent part of the educational experience—that it outlasts the leader who introduced it. By creating a strong leadership team, building community support, managing the changes expertly, and planning for long-term sustainability, skilled leaders can empower school systems to not only deploy mobile devices, but also use them in meaningful ways to improve student achievement and equity. This chapter shares strategies and best practices on several important leadership tasks for schools, states, and provinces:

- Developing a shared vision
- Creating a leadership team
- Building a culture of collaboration and innovation
- Planning and managing change

Develop a Shared Vision

Creating a shared vision is critical for second-order change in any setting. Given the strong feelings we all have about students and their future, it is especially important for education transformation. Early discussions with students, teachers, parents, policymakers, community members, and other stakeholders can help:

- Create agreement on the importance of education transformation and the enabling role of learning technologies
- Begin to define the intended outcomes, building recognition that the benefits of technology-enabled learning can extend well beyond student test scores, to matters such as improved graduation rates, decreased drop outs, improved behavior, increased time spent on task, and greater student engagement
- Motivate stakeholders to overcome disparate interests, focus on student learning, and work toward achieving the vision
- Bring concerns out into the open, where they can be addressed
- Build trust by establishing a foundation of transparency
- Rally the school and community around the urgency of the mission
- Secure resources and establish priorities when resources are limited

Create a Leadership Team

Educational technology initiatives involve interconnected issues and a wide range of stakeholders, so they benefit from collaborative leadership and a strong, cross-functional steering committee.

Collaborative leadership, with detailed planning conducted by a cross-functional team, can improve decision-making, produce a more practical and workable plan, and avoid surprises as the initiative proceeds. Seeking input broadly from stakeholders can build support for the initiative. Sharing opinions and viewpoints can increase trust and understanding, and enable issues to be identified and addressed early in the decision cycle.

For example, a device selection team that includes students, teachers, principals, curriculum specialists, ICT professionals, and parents can lead to smarter device selection: the ICT members can deepen their understanding of the capabilities needed for learning and teaching, and educators can become aware of ICT issues such as security and management. Together, they can develop and execute on a plan to select mobile technologies that meet requirements for curriculum, assessment, management, and security.

A team-oriented approach helps build leadership capacity throughout the school system. Collaborative leadership also increases sustainability and helps avoid the pitfalls of relying on a single charismatic leader, where an educational technology program may lose momentum when the initial champion departs.

Develop a Long-Term Roadmap

Roadmap planning for a large-scale educational technology initiative typically begins 12 months or more before students begin using mobile devices in the classroom. A five- to seven-year roadmap provides a framework for long-term success and helps focus stakeholders on the full scope of tasks needed for transformational use of technology.

Roadmap planning can begin with a needs assessment to identify current strengths and weaknesses. Analyzing the current situation for each area of the Intel Education Transformation Model can help leaders identify strengths, gaps, and weaknesses within the current system and establish practical priorities for how to move forward. The needs assessment can also include a review of past educational technology projects. If the school system has had any previous failures, it helps to understand how are those experiences may be influencing current perceptions so you can plan accordingly.

Planning includes creating detailed, comprehensive budgets, timelines, implementation plans, and schedules that encompass all elements of the Intel Education Transformation Model. Since success ultimately comes down to what happens between students and teachers, critical steps include those that support teachers and school leaders to modernize teaching strategies, select new content resources, and incorporate ICT to improve learning and teaching. While no one can foresee every issue that will come up, a broad, long-term plan helps build success.

Plan for Scale

Pilot programs or a phased rollout can increase the adoption of broad, sustainable changes by providing opportunities to evaluate and adjust the program before implementing it at scale. A phased approach can help leadership teams:

- Identify and address unforeseen consequences of changes
- Avoid getting mired in too much initial complexity
- Build capacity and expertise
- Increase confidence and enthusiasm for the changes
- Provide funders with evidence to justify program expansion

With highly effective leadership, large-scale educational technology programs can also be successful without pilots. The Huntsville School System, Huntsville, Alabama, U.S.A., spent a year in preparation and then moved successfully to district-wide mobile technology deployment to all 23,000 students at all 53 schools. (See *Insight: Leadership for a Fast-Moving Educational Technology Initiative*, in which Dr. Casey Wardynski, the district's superintendent, shares some of his leadership strategies.)

Advance the School Culture

In many successful technology-enabled learning initiatives, leaders transform the school culture in ways that facilitate ICT adoption and amplify its educational impact. Among these changes:

- **School as a learning community.** Incorporating ICT into effective teaching strategies requires courage, risk-taking, and innovation, especially when the goal is transformative, second-order change. Establishing a vision of the school as a learning community with teachers as the lead learners can accelerate the impact of ICT deployment. By combining innovation and accountability, and accepting mistakes as part of learning, leaders can empower teachers to use ICT in powerful ways that improve student learning. Enlisting parents as active collaborators and supporters of their students' learning can also help raise expectations for students and increase achievement.
- **Principal as chief change agent.** Principals are pivotal change makers and crucial to the success of any educational technology initiative. Effective principals serve as powerful role models who actively embrace change. They support stakeholders in managing their new roles and responsibilities, and ensure that teachers have the resources they need to succeed.
- **Collaborative teaching environment.** A collaborative, supportive teaching environment can reduce isolation, lessen the fear of change, and give teachers a safe environment in which to advance their pedagogy. Teachers can collaborate to design and create new curriculum, interdisciplinary projects, digital content, tools, and resources.

- **Students as drivers.** As teachers adopt new learning and teaching strategies, students increasingly become drivers of their own learning. Their voices should be heard throughout the planning and implementation of the educational technology initiative.
- **Continuous improvement.** Digital technologies provide a wealth of data that can support efforts to increase evidence-based decision-making. Effective school cultures can improve student outcomes by creating a cycle of continuous improvement driven by data and results and supported by an array of high-quality professional learning options.
- **Distributed leadership.** Building leadership capacity throughout the school system can increase organizational effectiveness, develop management and decision-making skills at many levels, and reinforce the benefits of a collaborative learning community. A lean or flattened management hierarchy generally provides greater agility than a larger, more bureaucratically encumbered environment. Involving teachers in school management can increase collaboration and build capacity.

Communicate and Collaborate

Even when they start as state-wide or national initiatives, successful learning technology initiatives involve teamwork among teachers, school leaders, students, school system personnel, parents, and state or provincial leaders. In addition, although the elements of the transformation model are interconnected, they are often siloed and handled by different stakeholders. Effective school leaders encourage clear and open communication and collaboration with teachers, students, parents, policymakers, administrators, and the community. Parents can be strong advocates for transformative educational technology initiatives if the school leadership cultivates them.



Leadership Implementation Checklist

Key Tasks

- Work with stakeholders across the system to create a vision and build success
- Develop and implement a flexible plan that addresses all aspects of the Intel Education Transformation Model

Steps to Success

Vision and Goal-Setting

- Align ICT initiatives with larger objectives. Focus on how ICT can improve student learning, align with the state's, province's, or nation's vision of the future, and support what's best for learners.
- Review the research and base your initiative on evidence-based best practices. Conduct team visits to innovative schools to see what practices have been effective for them.
- Conduct community meetings, teacher workshops, and study groups to discuss topics such as:
 - Why and how do we need to transform learning and teaching? How will this be better for students?
 - What are our core values? How can we ensure we change in ways that reflect these values?
 - What is our vision of success? What are we hoping to change or achieve?
 - What role will ICT play? How will teachers and students use mobile devices and digital resources to improve learning outcomes? What does the research tell us about the best ways to do this? What will we have to do to achieve the results we're after?
 - How will we know if we're succeeding? What will success look like? How will learning, teaching, and assessment be different?
 - What other changes might we expect to result?
- Identify and communicate concrete goals so everyone understands how you will measure success.

Establish a Planning Committee

- Create a cross-functional steering committee that is headed by the principal, includes necessary expertise, but is small enough to work effectively.
- Include teachers and administrators, students, and parents. Community members, employers, and nonprofits can also provide valuable insights and expertise.
- Ensure the chief financial officer (CFO) or other budget planners are active participants to help avoid funding surprises and establish a sustainable financial foundation.
- Once the initiative has launched, have the committee continue to meet monthly in the first year, then quarterly throughout the life of the initiative, or more frequently as needed. Use each meeting to review progress, identify issues that need immediate adjustments, and report to stakeholders to encourage transparency.

Develop a Roadmap

- Survey current, relevant research to base your approach on recognized best practices.
- Start planning 12 months or more in advance to address all aspects of the Intel Education Transformation Model.
- Conduct a needs assessment, identify target goals, and plan intermediate steps for:
 - Policies
 - Curriculum, pedagogy, and content
 - Assessment
 - Professional learning for teachers and ICT staff
 - Mobile devices for learning and teaching
 - ICT infrastructure, policies, and procedures
 - Sustainable resourcing
 - Research and evaluation
- Develop short-term and long-term implementation roadmaps. Include detailed milestones and provide oversight for execution. Work to build on current strengths and remediate weaknesses.
- Set clear goals and decide how you will measure success.
- Establish frequent checkpoints to measure progress, and be transparent about the results. Report progress to stakeholders and make adjustments as needed to create a cycle of improvement and keep everyone focused on the goals.

Scale the Program

- Consider one or more pilot programs or a phased rollout to test your approach before large-scale operation. Common methods of scaling include:
 - Establishing an initial program with several classes, subjects, grade levels, or schools, then extending participation until you have encompassed schools across the system, state, region, or nation
 - Using technology to support existing pedagogy, then expanding the scope of the learning environment as teachers master new teaching strategies and curriculum resources
- As you select the starting points for the program rollout, be sensitive to equity issues. To have the greatest positive impact on equity, consider conducting pilots or initial programs with the strongest teachers and most disadvantaged students.

Advance the Culture

- Evolve the school as a learning community. Create a collaborative, supportive environment in which teachers support each other in learning, innovating, and advancing together.
- Establish an expectation of continuous improvement and evidence-based decision-making. Work with policymakers to reward innovation and ensure accountability.
- Build the understanding that innovation and ICT adoption are never for their own sake. At every decision point, raise the question: How will this affect student learning and equity?
- Invite parents to be active collaborators and supporters of their students' learning. Use school portals and other communication technologies to involve them in the student's goal-setting and project reviews.
- Build long-term leadership capacity throughout the school system and the learning technology initiative. Having a broader leadership base helps expand the collective knowledge and expertise of the school community. This can accelerate change and help ensure that the changes outlast any one leader.

Communicate and Collaborate

- Involve stakeholders in planning the initiative. Transparent, two-way communication helps build support, trust, and understanding, which can minimize friction as you move forward.
- Keep all stakeholders informed about what will happen, why it's best for student learning, and how they can contribute to the initiative's success.
- Stay engaged as the initiative moves forward. Continue listening and responding to stakeholders' concerns, and keep reporting back—to share results, discuss issues and plans, and build pride in what is being accomplished.
- Offer information sessions or ongoing courses to keep families fully informed about changes that affect their students. If the digital divide is an issue in your community, helping family members understand and use student technologies can extend the benefits of your initiative and create closer bonds between school and home.
- Use all appropriate communication channels to communicate with families. Web sites, newsletters, blogs, social media, workshops, and discussion groups can all be useful. Avoid methods such as texting that may add costs for families.

INSIGHT

Leadership for a Fast-Moving Educational Technology Initiative

By Casey Wardynski, Ph.D., Superintendent, Huntsville City Schools, Huntsville, Alabama, U.S.
@HSVK12

Huntsville City Schools is an urban-rural district with 41 schools and more than 23,000 students in an area whose economy is driven by nearby aerospace and military technology research facilities.

I came to Huntsville City Schools in June 2011 with a mission of improving student achievement. Fifteen months later, Huntsville became one of the largest school systems in the United States to move to one-to-one digital learning across the district. We're still improving, but we are already seeing exciting results.

- In what we view as a sign of increased student engagement, discipline problems are down by about 35 percent across the school system, and school suspensions are down about 30 percent. We put wireless Internet access on our school buses, and the discipline problems there have declined by 76 percent.
- Graduation rates are up. The district as a whole went from 66 percent to 80 percent graduation rates in the past two years, and the schools that previously had the greatest disengagement experienced the biggest improvements.
- With these digital learning environments, we're finding it much easier to gauge the degree to which instruction aligns with the Common Core State Standards and to adjust our professional development strategies accordingly.



What advice can I offer on leading an educational technology initiative? Here are some practices that have helped us:

- **Work backwards from what you want to accomplish.** The point is not just to put a computer in a student's hands. You have to ask yourself, "And then what?" If you want to put your children in a learning environment that's engaging and brings lots of resources to bear and can help them collaborate, then that's a good starting point. That will take you in the direction of what kind of hardware you want. But if you start with the hardware and then figure out what you're going to do with it, you're probably going to find trouble.
- **Make the commitment clear.** You need to get everyone working toward the goal. We eliminated the old textbooks, so there was no hope of going backwards.
- **Give teachers what they need to succeed.** We did professional development across the board and committed to supporting our teachers to learn new ways of teaching. We do 30 days of professional learning in every school every year so teachers can really focus on moving ahead with digital learning.
- **Get principals involved.** In a digital learning environment, they're not just managing buildings. They need to be providing instructional leadership. We aligned principals' report cards so their incentive pay includes things like change of practice and use of technology, and when I meet with principals, we spend time looking at the data.
- **Find the funds.** We looked for operational efficiencies and reallocated money from textbooks to technology.
- **Celebrate the successes.** Nominate them for awards. Publicize them. They're the proof and the inspiration that it can be done.



A retired Army colonel, Dr. Wardynski served as the chief financial officer for Aurora, Colorado, Public Schools, and director of the Office of Economic and Manpower Analysis at the U.S. Military Academy before becoming superintendent of Huntsville City Schools in June 2011. He holds a Bachelor's Degree from the United States Military Academy, a Master's Degree in Public Policy from Harvard University, and a Doctorate in Policy Analysis from the Rand Pardee Graduate School. Follow Huntsville City Schools on Twitter: [@HSVk12](#).

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Citations

- 12 Robert J. Marzano, Timothy Waters, Brian A. McNulty, *School Leadership that Works: From Research to Results*, ASCD and MREL, 2005.

Resources

- Intel® Education provides tools, case studies, and guides to support education transformation based on global best practices:
 - <http://www.intel.com/content/www/us/en/education/k12/k12-educators.html>
 - <http://www.intel.com/content/www/us/en/education/evaluations/solutions-for-leaders.html>
- ASCD (formerly the Association for Supervision and Curriculum Development), *School Leadership that Works: From Research to Results*, <http://www.ascd.org/publications/books/105125.aspx>
- Edutopia has resources summarizing research into the benefits of project-based learning and other modern teaching strategies: <http://www.edutopia.org/research-resources>
- E-Lead, *Leadership for Student Success*: <http://www.e-lead.org/principles/principal.asp>
- OECD provides a range of resources for improving school leadership, including case studies and an interactive toolkit: <http://www.oecd.org/education/school/improvingschoolleadership-home.htm>
- OECD's Innovative Learning Environments Project draws best practices from a study of 125 innovative education projects around the world: <http://dx.doi.org/10.1787/9789264203488-en>.
- OECD's PISA site gathers papers analyzing what successful school systems around the world are doing to improve student achievement and equity: <http://www.oecd.org/pisa/>
- OECD's Education GPS site brings together data on how countries are working to improve quality and equity in their education systems, including policies and outcomes: <http://gpseducation.oecd.org/Home>
- Project RED, a research and advocacy group focusing on using technology to improve K-12 education, offers a global toolkit that includes tools for assessing readiness and developing an implementation timeline. Available from: <http://www.projectred.org/resource-materials.html>

Chapter 4 Policy: Setting the Framework for Success



Chapter Introduction by Thiam Seng Koh, Ph.D.

Principal
St. Joseph's Institution, Singapore

“To build success, policies should provide time, networks, resources, professional learning, and opportunities for collaboration, and a system of recognition and incentives for principals, teachers, and other school leaders.”

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The policy framework creates the conditions for success. Policies should align from the national level down to the school level to ensure that there is an ecosystem, structures, systems, processes, and monitoring to implement the education plan and support the effective use of technology for teaching and learning. Policies should also ensure that the plan is implemented with continuity and consistency, that the implementation is systematic, and that all the critical dimensions of the implementation work together to achieve the desired outcome: to face the challenges of the future. Technology use is not merely about improving test scores or using the latest technology. Learning must drive the use of technology. Technology must not drive learning.

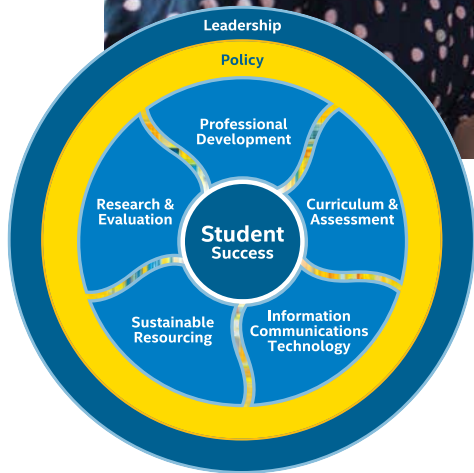
Teacher readiness is a critical area for policy formation. When teachers are ready, they can perform miracles. If teachers are not convinced or don't have the necessary skills, resources, and time, then nothing changes and your policy objectives will not be met. This is true for any change, not just ICT. Often, leaders are impatient—they want significant change within their term of office, but it takes time for teachers to trust you and make the changes. If you get teachers on board, the other dimensions are straightforward. If you don't, you tend to overinvest in other areas and not get the ROI you're looking for.

School leaders as well as teachers need to up-level their skill sets so they can help create the necessary conditions for success. Very often, principals do not have the support network they need. They are busy with the operational running of the school, and they don't invest time in their own professional learning. They need the skills to inspire teachers to change and create the structures that can enable them to use ICT effectively for teaching and learning.

To build success, policies should provide time, networks, resources, professional learning, and opportunities for collaboration, and a system of recognition and incentives for principals, teachers, and other school leaders. Effective policy can also include bringing in teacher-leaders to act as coaches for other teachers in their subject area, or bringing in scientists, artists, researchers and others into schools even though they do not have traditional certification. These outsiders can bring a perspective and help teachers reframe the learning situation.

Thiam Seng Koh

Former Director for Educational Technology at the Singapore Ministry of Education, Dr. Koh has experienced successful ICT-supported learning programs as an administrator, practitioner, researcher, and currently as a principal. Singapore's policies both within and outside education work together to support a knowledge-driven economy, and its students are among the world's top performers in mathematics, reading and science literacy.



A Practical, Flexible Framework

In a fast-changing world, staying within one's comfort zone is a sure way to fall behind. Education policies must promote evidence-based innovation to ensure that all students obtain the skills, knowledge, traits, and abilities to thrive in a rapidly advancing, knowledge-based economy and society.

Policies can accelerate progress toward transformational use of educational technologies, or present roadblocks that slow progress. Flexible policies at the national, state or province, and school levels should work together to encourage innovation and empower educators to use ICT in ways that advance learning and teaching.

An effective policy framework incorporates the changes needed to align curriculum and assessment, professional development, teaching practice, ICT, and other elements of the Intel Education Transformation Model, so they work together to achieve the objectives of the transformation initiative. Policies for educational technology initiatives should optimize the use of technology as a platform for learning and teaching while protecting students and maintaining data privacy. Effective policies:

- Are flexible, practical, action-oriented, and evidence-based
- Focus on learning outcomes
- Support fairness and equity
- Encourage local autonomy and innovation while ensuring accountability
- Are consistent and coherent across school, state, and national levels

This chapter discusses representative areas of policy for ICT-supported learning.

Acceptable Use

Acceptable use policies (AUP) define expectations for how students, educators, and parents will use technology and behave as digital citizens. These policies should focus on keeping students safe online while providing flexibility for learning and teaching. AUPs should also identify consequences for inappropriate use, such as cyber-bullying, violating copyright protections, or circumventing web filtering software. As in other areas of policy, AUPs for schools and school systems must conform to national, state, or regional policies regarding digital citizenship.

Curriculum and Assessment

It's counterproductive to train teachers on new pedagogies but limit them to old textbooks and fixed curriculum maps. Similarly, it's not helpful to implement inquiry-based, project-based learning, but rely exclusively on multiple-choice tests. To fully benefit from ICT deployment, it's important to examine policies pertaining to curriculum standards, content, and assessment, and then modernize, unify, and align them around the goals and objectives of educational transformation.

Policies that encourage flexibility in the choice of textbooks and digital content can accelerate local innovation and assist teachers to create personalized learning paths for their students. Effective policies also:

- Promote the use of ICT-enabled formative and summative assessments to improve learning outcomes
- Enable students to demonstrate their learning through e-portfolios and digital outputs

Data Privacy

Data collection and analysis are essential for personalizing the student's educational experience and making evidence-based decisions about learning, teaching, and program effectiveness. Transparency in sharing aggregate achievement data is a valuable aid to accountability and increased learning. However, care must be taken to protect the privacy of confidential data. As with acceptable use policies, data policies should aim to provide maximum educational value while reflecting community values. Parents should participate in data privacy decisions for their children, and vendor contracts should prohibit service providers from selling or inappropriately using or disclosing data. Policies should establish:

- What data will be collected
- How data will be used and stored
- Who can access it
- Who must be notified when data is shared
- How any data breaches will be handled

Digital Learning, Virtual Learning

Virtual learning and distance learning can reduce costs, supplement local teachers, and enable students in remote or rural areas to access high-quality content and resources that might not be available otherwise. Effective policies facilitate appropriate sharing of digital content, offer course credit for distance learning courses, and enable students to enroll in e-courses beyond their home districts or school systems. As in any field where rapid change is occurring, policies and practices should also ensure that digital resources and virtual learning courses meet high standards of quality and relevance.

Equity

Educational technology initiatives can make a significant contribution to increased equity. Policies should emphasize providing equal access to digital devices and resources for all students. Bring-your-own-device (BYOD) programs can be particularly problematic in terms of equity, so any use of BYOD must take care not to widen any digital divide that may exist in the school community.

Policies that support differentiated and personalized learning experiences can improve achievement for all learners and provide flexibility in meeting the needs of students with differing physical, cognitive, and other abilities. Policies should:

- Empower teachers to create personalized learning experiences that align with each student's motivation, learning style, and abilities
- Provide flexibility in how students engage, respond, and demonstrate knowledge and skills

Policies to support a wireless community can expand the return on investment in mobile devices and further increase opportunities for equity. By collaborating with community and business leaders, school leaders and policymakers can enable students to access educational resources from home as well as from community centers, libraries, and other public locations. This approach can also afford access to family members, involving parents more closely in their children's learning.

Flexible Scheduling and Graduation Requirements

Traditional school schedules and graduation requirements are often a holdover from the one-size-fits-all, factory-era model of education. Modern policies align with 21st century education requirements by focusing on learning outcomes and achievement rather than hours in class or years in school. Flexible policies can increase educational efficiency and facilitate real-world activities such as internships, independent research, and community service. These learning experiences can kindle a student's passion, offer real-world relevance, increase awareness of the work world, and develop 21st century or transversal skills such as problem solving and critical thinking.

Scheduling the school day with longer blocks of time can improve learning outcomes by facilitating project-based learning, independent study, and other learning experiences. Flexible policies also enhance innovation by enabling schools and school systems to extend the school day or school year, or implement after-school tutoring programs.

Professional Learning

Reflecting the crucial importance of teachers to the success of a learning technology initiative, effective policies provide time, support, and resources for professional learning for teachers, principals, curriculum specialists, ICT staff, and others. In addition to professional development, the policy framework must ensure that educators have adequate time for curriculum development, content selection, and lesson planning, both before deploying educational technologies to students and on an ongoing basis.

Teacher Qualification and Support

ICT delivers its impact when enthusiastic, highly skilled teachers incorporate it into powerful learning and teaching strategies. Effective policies recruit strong teachers, support and encourage their professionalism, continue to invest in them, and align assessment and rewards to support innovation in teaching.

Alternate route certification is one option for recruiting teachers and aligning education with workforce trends. These policies can allow highly credentialed individuals with strong subject-matter expertise and industry or academic experience to teach while completing coursework and on-the-job mentoring.

Policy Implementation Checklist

Key Tasks

- Establish a robust, flexibility policy framework that reflects the scope of the educational technology initiative, encourages innovation and accountability, and promotes transformative use of ICT

Steps to Success

- Collaborate with state, national, and regional policymakers to review and update the policy framework. Strive for a coherent, flexible framework that aligns policies regarding curriculum standards, content, assessment, professional learning, teacher evaluation, and other relevant areas.
- Involve a wide range of stakeholders in policy formation: teachers, students, administrators, parents, community members, and others depending on the area of focus.
- Join with other schools, school systems, educational organizations, and government representatives to influence the development of policy standards as needed.
- Streamline procedures so that future policy adjustments can be made without undue bureaucracy.
- Communicate policies to all stakeholders.
- Review and update policies regularly to ensure they keep up with evolving requirements.

Develop policies that:

- Maximize the value of investments in mobile devices by facilitating their use throughout the school day and beyond. Promote one-to-one (or more) device deployment, implement ubiquitous wireless networks, and consider collaborating with government, business, and community organizations to create a community wireless network.
- Build success by allowing time to plan and manage all aspects of an educational technology initiative. For a major initiative, expect to spend a full year in holistic planning, policy refresh, modernizing and aligning curriculum and assessment, professional learning, content development, and creating an anywhere, anytime digital learning environment.
- Empower teachers, principals, and other school leaders to make the fullest use of digital platforms and resources before the initiative and as you move forward. Provide ongoing time, resources, and support for continued planning and evaluation, professional learning, lesson planning, content selection, and other aspects of transformation. Promote the use of instructional coaches and mentors.
- Support self-directed, blended-learning options for professional development. Offer continuing education credits for just-in-time online courseware.
- Support the use of high-quality virtual learning, distance learning, and digital content resources. Shift textbook funds to digital content and platforms.
- Ensure that virtual courses and digital content meet high expectations for rigor and appropriateness.
- Give students flexible ways to meet graduation requirements and demonstrate mastery of curriculum requirements, including 21st century, transversal skills.
- Ensure that device choices and infrastructure planning start from the learning objectives and curricular requirements.
- Define responsibilities and procedures in case mobile devices are lost, stolen, or damaged. Aim for an approach that encourages students to take responsibility for their devices but avoids burdening families unduly. Work with insurers to offer coverage that meets the needs of schools and families.
- Safeguard confidential information by establishing what data will be collected; how it will be used, accessed, and stored; and how any data breach will be handled. Review contracts with software and service providers to limit or forbid the use or sharing of student data for anything other than its intended educational purposes. Conduct security audits to ensure privacy policies are being followed.

CASE STUDY

A Robust Policy Framework in Singapore

In less than 50 years, Singapore has transformed from an impoverished nation with no compulsory education to an economic powerhouse whose students lead the world in a variety of education metrics. Most recently, Singapore's 15 year-olds scored highest among 40 OECD nations on the 2012 PISA assessment of problem solving.

Singapore's success stems in part from a long-term commitment to education and a coherent policy framework. Since 1997, Singapore's leaders have created three five-year master plans for education, each focused on preparing students to lead in the global knowledge economy and each including a strong ICT element. The most recent master plan emphasizes the importance of delivering a student-centric, values-driven education organized around a vision of engaged learners, high-quality schools, caring educators, and parents as supportive partners. Elements of Singapore's policy framework include:

- Encouraging local innovation within a consistent overall framework
- Aligning education with the nation's social and economic objectives and a clear vision of the future
- Making a strong commitment to success for every student
- Placing a high value on teachers, including recruiting from the top third of graduates and providing differentiated professional learning for educators on the job
- Using ICT to support curriculum and assessment goals
- Creating synergy between the use of ICT in education and throughout Singapore's society and economy
- Taking a holistic and systematic approach to planning and implementation
- Ongoing research to identify what works—both to modify and improve Singapore's own practices and to learn from others around the world

Read about projects conducted by the Singapore National Institute for Education's Centre for Research in Pedagogy and Practice: <https://www.nie.edu.sg/research-centres/centre-research-pedagogy-practice-crpp>.

See OECD's profile of Singapore education: *Singapore: Rapid Improvement Followed by Strong Performance*, 2010. <http://www.oecd.org/countries/singapore/46581101.pdf>



15-year olds scored **highest** among 40 OECD nations on PISA **problem solving**

Strong commitment to the success of **every student**



Resources

- The *Intel® Education Transformation Policy Guide* (Robert B. Kozma, Ph.D., principal author, 2013) provides a four-phase model for developing national and state policies to support education transformation. The guide features case studies, reports, best-practice policy documents, videos, and other resources, and an online tool is also available. Download the guide at: <http://www.intel.com/content/www/us/en/education/evaluations/ict-policy-development-guidebook.html>
- The Landmark for Schools Project's AUP 2.0 is a wiki with resources and examples of acceptable use policies: <http://landmark-project.com/aup20/pmwiki.php>
- McRel International, formerly Mid-Continent Research for Education and Learning, provides resources on balanced leadership: <http://www.mcrel.org/>
- UNESCO *Transforming Education: The Power of ICT Policies*, edited by Robert B. Kozma (2011): <http://unesdoc.unesco.org/images/0021/002118/211842e.pdf>

Chapter 5 Professional Development: Empowering Educators to Transform Learning and Teaching



Chapter Introduction by Anjee Prakash, Ph.D.

CEO
Learning Links Foundation, India

“Teachers, supported by the relevant technology tools and the right professional development, can make magic in the classroom.”

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Teachers are in constant search for tools that can make their classrooms more engaging, more dynamic, richer, and more fulfilling. Technology tools add value to education across the spectrum, from elite private schools to single-teacher village schools. Teachers, supported by the relevant technology tools and the right professional development, can make magic in the classroom. At Learning Links Foundation, we understand the potential of technology and the needs of teachers, and it is through our customized professional development offerings that we empower teachers to use technology to help improve student learning.

It is often said that teachers teach the way they were taught, but given how fast the world is changing, we need new approaches. We all need to be learners, and we need to create school cultures that embrace that. This means that principals, teachers, curriculum coordinators, librarians, and others need professional development to support them as they move forward.

Professional development should be ongoing, relevant, and meaningful to each individual's needs, just as the student experience should be personalized for each child's needs. Professional development must enable teachers and others to acquire the skills, perspectives, and confidence to use technology with new pedagogical approaches to prepare students for the modern world and empower students to achieve the goals they have for their lives. It should build teachers' expertise with new teaching and assessment strategies, including the use of data analytics to improve instruction.

Defining a more collaborative and innovative school culture is a joint responsibility of principals, teachers, and other stakeholders. Principals need professional development to develop the skills they need to lead the implementation of new approaches and move the whole school forward. In contrast to the traditional isolation of teachers in their classrooms, the learning culture must make it safe for teachers to try new approaches, collaborate in new ways, and ask for help when they need it.

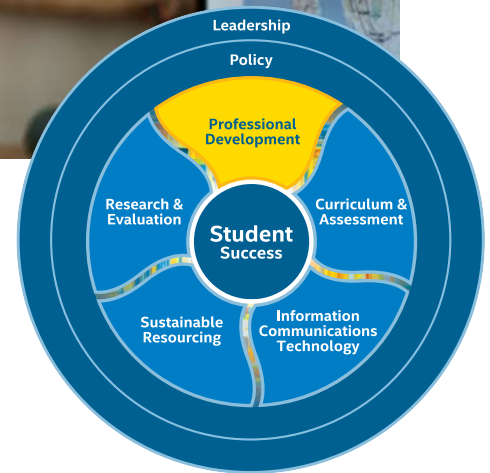
High-quality professional development enables educators to cope with and ultimately embrace the rapid pace of change. Just as doctors have continuing education to keep up with their professions, ongoing professional development can help teachers stay relevant and up to date. Professional development should provide teachers with a career path, allowing them move ahead as their skills grow.

Meaningful and effective professional development transforms what students achieve and produces an economic impact. Recent analysis by scientists from Harvard University, Columbia University, and the Brookings Institute found that students with good teachers earn more over their lifetimes.¹³ Good teachers are worth their weight in gold—literally. Empowering teachers through professional development and other supports may also reduce burnout and improve teacher retention.

Teachers do great work. If they see the value in using technology to achieve their goals and are equipped with the skills and supports they need, they will use technology in ways beyond what we could imagine—and our children will be the better for it.

Anjlee Prakash, Ph.D.

As head of Learning Links, Dr. Prakash leads a global foundation that works with public and private organizations to develop sustainable educational policies and solutions in India and around the world. She has collaborated with organizations such as UNESCO and the Brookings Institution to define educational goals and effective methods of achieving and assessing them. She has a Doctorate in Education and 24 years of experience in the field of education, training, and educational technology.



Teacher Success, Student Success

Transformative change brings opportunities and challenges for teachers, principals, policymakers, and societies. How do we:

- Increase equity while raising expectations for every student?
- Meet curriculum standards while igniting each student's creative spark?
- Improve student outcomes by incorporating technology into rigorous, student-driven learning experiences that are relevant to real-world problems?
- Honor the art of teaching while empowering teachers with the science of new, analytics-based assessments?

Professional development is pivotal to mastering these challenges, taking advantage of the opportunities, and making sustainable improvements in student learning. Ongoing, high-quality professional learning for teachers, educators, and administrators can help:

- Empower educators to develop competence and confidence in working with new learning models, curriculum resources, assessment methods, tools, and technologies
- Enable students to benefit from a student-centered, 21st century education
- Ensure that technology investments are used to achieve the program's goals

Project RED found that giving teachers time for professional learning and collaboration at least once a month and training school leaders in how to facilitate second-order change are best practices of successful education technology programs.¹⁴

This chapter discusses:

- How teachers' jobs are changing
- What professional learning needs to cover
- Strategies for implementing a professional learning program

New Learning Models, New Roles: Professional Development for Teachers

Professional development must empower teachers to apply the capabilities of a data-rich, technology-infused learning environment, apply new learning strategies, and deliver a personalized education for each student. Effective professional learning also prepares teachers to take on transformative new roles. More than traditional dispensers of knowledge, or even enablers or supporters of student learning, teachers become directors and activators, igniting each student's unique learning path. Reflecting the rapid growth of new knowledge, teachers act less as all-knowing experts, and more as lead learners and confident explorers.

Fullan¹⁵ and others identify three new roles that teachers take on in a transformed environment:

1. **Designers of personalized learning experiences.** Teachers collaborate with students to co-design challenging learning activities that move each student toward the curriculum objectives. Teachers know their students well enough to co-create experiences that are relevant to each student's cognitive needs, content knowledge, and interests.
2. **Sources of human, social, and decision-making capital.** Teachers are continuous learners and innovators. By building personal and organizational capacity and expanding their networks, they increase their own and others' ability to design effective learning experiences for their students.
3. **Partners in learning with their students, accelerated by technology.** Teachers incorporate technology into new pedagogic strategies that build on meaningful, creative relationships between teachers and students. They co-create knowledge, using modern technologies to activate 21st century learning and not simply to deliver traditional content electronically.

Successful professional learning also enables teachers to build mastery of new assessment methodologies, both standards-based assessments that align with curriculum changes, and formative assessments that teachers can use to improve instruction in real time. With digital content providing more data and formative assessments and standardized tests evolving, professional development can enable teachers to:

- Choose and use the appropriate assessment tool for the purpose
- Make effective use of test results, whether they come from classroom quizzes, standardized assessments, formative tests built into digital content, or artifacts and projects that students create to demonstrate their mastery
- Design new ways to assess students' development of 21st century skills

The International Society for Technology in Education (ISTE) Standards for Teachers provide a useful summary of teacher requirements (Table 5-1).

ISTE Standards for Teachers¹⁶

Focus	Requirements
Facilitate and inspire student learning and creativity	Use their knowledge of subject matter, learning, teaching, and technology to facilitate experiences that advance student learning, creativity, and innovation in face-to-face and virtual environments
Design and develop digital age learning experiences and assessments	Design, develop, and evaluate authentic learning experiences and assessment incorporating contemporary tools and resources to maximize content learning in context and to develop the knowledge, skills, and attitudes identified in the ISTE Standards for Teachers
Model digital age work and learning	Exhibit knowledge, skills, and work processes representative of an innovative professional in a global and digital society
Promote and model digital citizenship and responsibility	Understand local and global societal issues and responsibilities in an evolving digital culture and exhibit legal and ethical behavior in their professional practices
Engage in professional growth and leadership	Continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community by promoting and demonstrating effective use of digital tools and resources

Table 5-1

Leading Transformative Change: Professional Development for School Leaders and Administrators

School leaders, principals, and other administrators need professional learning to support their roles as change agents and provide them with the skills to:

- Inspire and manage large-scale change
- Establish a culture of continuous improvement
- Lead teachers in incorporating technology in to their practice and using it to enhance learning outcomes

Project RED's research identifies effective change management and school leader training as characteristics of schools and school systems that achieve the greatest impact from technology-enabled transformation initiatives. Table 5-2 summarizes areas that ISTE identifies as critical for educational administrators.

ISTE Standards for Educational Administrators¹⁷

Focus	Requirements
Visionary leadership	Inspire and lead development and implementation of a shared vision for comprehensive integration of technology to promote excellence and support transformation throughout the organization
Digital age learning culture	Create, promote, and sustain a dynamic, digital-age learning culture that provides a rigorous, relevant, and engaging education for all students
Excellence in professional practice	Promote an environment of professional learning and innovation that empowers educators to enhance student learning through the infusion of contemporary technologies and digital resources
Systemic improvement	Provide digital age leadership and management to continuously improve the organization through the effective use of information and technology resources
Digital citizenship	Model and facilitate understanding of social, ethical and legal issues and responsibilities related to an evolving digital culture

Table 5-2

Implementing Professional Learning Programs

Effective professional development follows the same personalized, learner-led approaches that are so powerful with students. As you develop or expand your professional learning program, aim for a blend of face-to-face, online, and blended courses, along with mentoring and coaching, social media, and professional learning communities of practice.

- **Personalized.** You may want to start with some required introductory sessions, but most professional development can be conducted via a personalized, learner-driven approach. Self-paced professional development respects teachers as professionals who understand their own learning needs and how to meet them. Concentrate on providing the right combination of resources, support, and accountability, and empowering teachers to create their own learning path.
- **Blended.** Successful professional learning generally involves a mix of face-to-face and digital resources. Online resources are cost-effective, and can be accessed as needed. Face-to-face discussions, mentoring, and coaching are invaluable, particularly when they include opportunities to try a new approach, reflect on it, and debrief with a peer or mentor. The state of Pernambuco, Brazil is using a blended approach to help science teachers learn how to design and incorporate virtual experiments into their pedagogy. See *Case Study: Transforming Science Education in Pernambuco, Brazil*.
- **Collaborative.** On-site coaches and mentors, either full-time or on a regular basis, can offer welcome support, direction, and modeling. Online communities of practice can provide equitable access to human and information resources that may not be available locally. These virtual communities use networking technologies to increase communication, collaboration, and support among teachers, administrators, researchers, and other related professionals and stakeholders. Project RED found that in-class mentoring is one of the most effective types of professional learning for teachers.
- **Supportive.** In successful transformations, school leaders support teachers as they try new approaches, and the school culture balances risk-taking and innovation with results and accountability. Online communities of practice enable teachers with similar interests and professional needs to share resources and ideas formally and informally. Principals and team leaders model an attitude of, "We're all learning together. We're all accountable, but we're courageous in venturing into new areas. We accept that mistakes are a valuable part of learning."
- **Ongoing.** Professional learning cannot be a one-time experience. Refine your program by asking for feedback and conducting classroom observations and evaluations. Provide time and opportunities for teachers to practice, share, reflect on, and deepen what they're learning.

Professional Learning Implementation Checklist

Key Tasks

- Improve learning outcomes by empowering teachers, principals, and others with ongoing professional development that is personalized, supportive, and collaborative

Steps to Success

Design professional learning for teachers to cover:

New roles and learning models

- Embracing change, becoming role models for innovation
- Raising expectations for all students
- Activating students for independent learning

Curriculum, content, and lesson planning

- Understanding and applying new learning models and teaching strategies
- Designing and managing student-centered learning environments, personalized learning experiences, inquiry-based projects, etc.
- Choosing and using high-quality digital resources and content to engage students in active learning, provide deeper learning experiences, and meet diverse student needs

Assessment

- Using new data sources and assessment tools to optimize student outcomes, including methods of self-evaluation, evaluation by peers and experts, and summative and formative assessments
- Developing student-centered assessment strategies
- Aligning teaching practice with evolving assessment standards and new learning models
- Developing methods to assess student output of collaborative learning, project-based learning, etc.

Tools and solutions

- Creating online workspaces for students to collaborate, analyze complex information, pursue investigations, and solve problems
- Using learning management systems, classroom management solutions, and other tools to improve educational productivity and results

Provide professional learning to help principals and other administrators:

- Build expertise in large-scale change management, including communicating the vision of transformation and working collaboratively with teachers, the community, and other stakeholders to implement change
- Provide instructional as well as operational leadership
- Lead in creating a school culture that raises expectations for all students, reduces teacher isolation, and inspires creativity, innovation, and accountability
- Ensure that teachers have the time, resources, and support to engage in meaningful, ongoing professional learning
- Ensure that professional learning covers all relevant aspects of education transformation
- Understand new methods of assessment and increase everyone's expertise in evaluating new forms of evidence
- Increase data literacy and use new data sources to enhance teaching practice and learning outcomes
- Implement new approaches to teacher evaluation that reflect the teacher's expanding role

Preparing for an Educational Technology Initiative

- Gather and use data to design your professional development program. Start from your program goals, curriculum framework, and desired learning outcomes, and work backward. Identify the skills needed by teachers, principals, and others, and conduct a needs assessment to identify gaps.
- Work with teachers, curriculum specialists, principals, educational technology experts, and other stakeholders to develop an integrated, ongoing plan for professional learning. Create specialized modules that are relevant to the various stakeholders, and use a mix of methods.
- Start early. Provide teachers with laptops and get your professional learning program well underway before deploying devices to students.
- Work with policymakers to ensure teachers have time, both initially and on an ongoing basis, to evaluate new curriculum approaches, choose content and resources, and develop expertise in using digital resources for greatest educational impact.
- Start with school-wide or system-wide professional learning, and move to smaller-scale activities for departments, teams, and individuals. Consider a three-step ladder where teachers learn new tools and technologies, learn how to integrate them into their lesson plans, and then have ongoing opportunities to work with colleagues and mentors to refine and expand their expertise.
- Identify teachers who are enthusiastic adopters. Use them as mentors and coaches, and have them demonstrate new resources and lesson plans.
- Invest in a solution for managing human capital. Well-designed human capital management (HCM) systems can help you build teachers' strengths and track their professional development progress. These systems may also be useful in reducing the impact of teacher shortages and optimizing teacher placement to increase student learning.

Evolving Professional Learning as the Initiative Moves Forward

- Align technology usage with curriculum goals and requirements. Conduct technology-related professional learning within the context of curriculum, content, and assessment strategies.
- Ensure teachers have the resources and support they need to succeed. Have principals, technology/curriculum specialists, and others stay in close touch with them.
- Continue to offer a variety of professional development options. Focus on just-in-time professional development in which teachers drive their own learning.
- Monitor the results of your professional learning programs, and use the feedback to increase success. Are teachers using what they've learned and applying it in the classroom? If not, what additional support, incentives, or resources do they need?
- Create teams of expert teachers, curriculum specialists, instructional technology specialists, and others who can serve as mentors. Implement team-teaching assignments that pair hesitant teachers with those who are more confident.
- Implement a system of recognition and incentives. Use staff meetings and team meetings to highlight successes and innovations. Provide successful innovators with opportunities to present their work and gain recognition beyond the immediate school environment.
- Inspire culture change and innovation by modeling an attitude of openness, exploration, and excitement. Ask "what if" questions, and don't be afraid to admit when you don't know the answers.
- Adjust teacher evaluations to encourage the effective use of technology and adoption of new learning strategies. Develop plans to rectify shortcomings as needed.



CASE STUDY

Transforming Science Education in Pernambuco, Brazil

The state of Pernambuco in northeastern Brazil has a population of 9 million people in an area of almost 99,000 sq km. Pernambuco's government has made a broad commitment to transform education as a means of advancing social and economic progress. Pernambuco has distributed more than 176,000 Intel® classmate PCs to high school students within the state, and is using Intel® Education Lab Camera by Intel-lisence as part of Pernambuco's comprehensive, multi-year, BRL 1 million effort to modernize pedagogy and curriculum and align it with technology.

Professional learning is part of Pernambuco's plan to gain the full educational value of its technology investment. Pernambuco is providing science software training to 800 high school physics teachers, as well as to undergraduate physics students at the Federal University of Pernambuco (UFPE) and to all physics students in undergraduate teaching courses in Pernambuco institutions.

By using the Intel Education Lab Camera together with modern pedagogic methods and mobile computers, teachers can engage students in rigorous experiments quickly and easily, without the need for expensive equipment. Students can control their experiments and bring them to life, which helps learners grasp scientific concepts and increase motivation. The government gains a cost-effective way to enhance science education, improve teacher productivity, and expand the value of its investments in mobile computing and infrastructure.

"We are changing the way we educate our students and use technology as an enabler for the student-centered learning focus of Education 3.0," says Anderson S. L. Gomes, former State Education Secretary (2011/12), Governor Special Advisor for Education, Science and Technology (first semester 2013) in Pernambuco, and now back full time as Associate Professor in the Department of Physics at UFPE. "We are taking a holistic approach and moving to the 21st century. We are changing the technology we provide our students, the way we train our teachers, and the curriculum we adopt. This will be more efficient than using old-fashioned tools, and it will develop 21st century skills for our students."



Get students **excited** about science



Enable even non-science trained teachers to **engage** students in rigorous experiments



Government **cost-effectively enhances** science education

Citations

- 13 See [Measuring the Impacts of Teachers I: Evaluating Bias in Teacher Value-Added Estimates](#), and [Measuring the Impacts of Teachers II: Teacher value-added and student outcomes in adulthood](#), both by Raj Chetty, John Friedman, and Jonah Rockoff, NBER working paper 19423 and 19424, September 2013.
- 14 T. Greaves, J. Hayes, L. Wilson, M. Gielniak, and R.F. Peterson, *Project RED: The Technology Factor: Nine Keys to Student Achievement and Cost-Effectiveness*, MDR 2010. Available for download at <http://www.pearsonfoundation.org/great-learning/research-reports-and-surveys/project-red-the-technology-factor.html>.
- 15 Michael Fullan and Maria Langworthy, *Towards a New End: New Pedagogies for Deep Learning, Collaborative Impact*, 2013.
- 16 <http://www.iste.org/docs/pdfs/nets-t-standards.pdf>
- 17 <http://www.iste.org/docs/pdfs/nets-a-standards.pdf>

Resources

- The UNESCO ICT Competency Framework for Teachers (ICT-CFT) project provides training modules and implementation guidelines to help advance teachers' expertise in using ICT to improve the quality of education, reduce poverty and inequity, and raise standards of living. See Version 2.0, 2011, of the framework: <http://www.unesco.org/new/en/unesco/themes/icts/teacher-education/unesco-ict-competency-framework-for-teachers/>
- Intel® Education offers proven, professional teacher development courses and activities for 21st century skills, and is the largest, most successful program of its kind: <http://www.intel.com/education/teach>.
- Teachers Engage is Intel's online community offering classroom resources, online courses, and active dialogue within a global network. Participants collaborate and interact with other educators, creating private learning spaces and hosting or attending in live webinars. Join the community at: <http://engage.intel.com/community/teachersengage/>
- The professional development association ASTD offers training and resources for educators and others: <http://www.astd.org/Education/About/ASTD-Education>
- Connected Educators (ConnectED), an initiative of the US Office of Educational Technology, offers resources to support educator learning and collaboration through online communities of practice and social networks: <http://connectededucators.org/briefs/online-communities-of-practice-for-educators/>
- Michael Fullan and Katelyn Donnelly provide a guide to identifying which digital content solutions offer the greatest potential for transformation: *Alive in the Swamp: Assessing Digital Innovations in Education*, Nesta and NewSchools, 2013. For more about teachers as activators and other new roles, see Michael Fullan, *Stratosphere*, Pearson Canada, 2013.
- The New Media Consortium (NMC) Academy, founded by ISTE with dozens of universities and NGOs in 15 countries, offers free, online courses and other resources for teachers of students in grades 6 through college: <http://academy.nmc.org/>
- For an overview of professional development for school leaders, see eLead, *Principal Professional Development: Goals, Processes, Content & Design*: <http://www.e-lead.org/principles/principal.asp>

Chapter 6 Curriculum and Assessment: Strategies and Resources to Activate Learning



Chapter Introduction by Cristián Rizzi

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“As teachers change the way they teach, technology is providing powerful new ways to assess student progress, both to improve outcomes by providing immediate and highly targeted feedback, and to increase accountability.”

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In the hands of capable, well-supported teachers, digital content and resources can help students develop the skills and attitudes they need for the 21st century. These include cultural understanding, creativity, teamwork, critical thinking, digital citizenship, and others. Teachers can also use technology to help develop students' attitudes and ability to consider others' opinions and ideas, as well as a sense of fraternity and altruism. These skills and attributes are necessary for graduates whether their goal is to work in the corporate, government, not-for-profit, or other sectors of the workforce.

However, technology will only fulfill its potential if we focus on pedagogy rather than technology itself. Otherwise, the technology is just cosmetic. Pedagogy must move away from lectures, and learning must become student-centered, project-based, and hands-on.

Along with professional development, teachers need time and opportunities to work collaboratively, evaluate resources, and adopt new teaching strategies. They also need excellent digital content, and in emergent countries it's important to fund collaboration among universities, technology experts, and educators to create that content. New content and curriculum resources are emerging that align with emerging curriculum standards. As with any fast-changing area, teachers and curriculum specialists will want to evaluate these to ensure they meet the school system's quality standards. Teachers should be granted flexibility in adapting these new materials to provide personalized, inquiry-driven learning experiences.

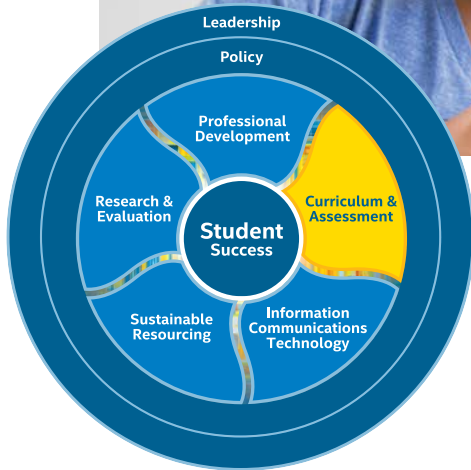
Empowered with the right digital resources and teaching strategies, teachers can use powerful digital platforms to:

- **Connect curriculum with real-world issues** that students care about—both by exposing students to richer content resources, and by bringing experts into the classroom via digital media and video conferences.
- **Bring abstract concepts to life.** Whether by seeing molecules in 3D, simulating a chemical reaction, or doing dynamic geometry, digital resources help teachers build scaffolds that move students to mastery of sophisticated concepts.
- **Visualize learning.** With tools such as graphic organizers and concept maps, teachers can see what students are thinking.
- **Inspire students' creativity.** Students gain new ways to express themselves and create. In addition, students find educational video games exciting because they are in control. They can choose own path, make their own creations, and ignite their imagination.

As teachers change the way they teach, technology is providing powerful new ways to assess student progress, both to improve outcomes by providing immediate and highly targeted feedback, and to increase accountability. The challenge is to keep curriculum, teacher practice, and assessment in sync, and to provide professional development and support so that teachers—and ultimately students—can achieve the fullest benefit.

Cristián Rizzi

Based in Argentina, Cristián Rizzi is an education innovator who develops curricula and content resources and works with teachers and school systems in Latin America and other Spanish-speaking countries. His focus is science education. He has had a 25-year career in education and technology, and holds advanced degrees in Educational Management, Information Technology, and Chemistry Education from universities in Spain and Argentina.



New Ways of Learning, Teaching, and Assessment

Mobile computers deliver the greatest educational impact and the strongest return on investment when they're paired with modern curricular frameworks, teaching strategies, digital resources, and assessment methods. In addition to engaging students with exciting interactive capabilities, data-rich digital content can empower teach-

ers to create more evidence-based teaching strategies that help all students reach their full potential. In a transformed learning environment, schools become learning communities, teachers become guides and facilitators, and students become active learners and problem solvers. To help achieve that transformation, this chapter covers:

- Modernizing the curricular framework
- Using digital learning environments to support next-generation learning
- Incorporating ICT into new teaching strategies
- Choosing digital content and resources to support curriculum objectives and meet other requirements
- Aligning assessment with evolving curriculum standards to improve learning outcomes

Modernizing the Curricular Framework

Modern curricular frameworks, aligned with effective assessments, are essential elements of education transformation. A more modern framework can better reflect the aspirations of 21st century students and the requirements for success as next-generation college students, workers, and citizens. Effective curriculum frameworks encompass subject-matter requirements as well as 21st century or transversal skills such as collaboration, communication, and critical thinking.

Assessment needs to change to reflect the new curriculum. In the United States, for example, the Common Core State Standards (CCSS) provide voluntary, internationally benchmarked K-12 standards and graduation requirements for math and English language arts. The CCSS initiative also creates a new framework for assessment that aims to strengthen accountability and align curriculum with assessment.

Flexible, well-written standards and frameworks recognize the importance of student-driven, personalized learning. Effective curriculum frameworks and school cultures give teachers wide flexibility to develop lesson plans and teaching strategies that implement the standards while delivering student-centered, personalized learning experiences.

Platforms for Learning

Digital learning environments support teachers in their mission to build academic success and enable students to reach their highest human potential. As Figure 6-1 shows, highly skilled teachers use ICT to:

- **Customize the learning experience** to match each student's cognitive strengths, learning style, and interests. Early in the transformation cycle, this can be as simple as teaching a whole-class lesson with the reading assignment calibrated to different ability levels. As transformation moves forward, it can shift into a fully personalized, student-centered environment in which students take control of their learning and teachers act as activators, guides, and facilitators.
- **Expose students to a vast universe** of content and resources, including adaptive software that adjusts the presentation of content based on the student's interactions with the material. Digital content can increase engagement and retention through capabilities such as video, audio, graphics, animations, virtual reality, simulations, and gaming.
- **Activate and engage students** in inquiry-driven projects that are based on solving real-world problems and relevant to students' lives and passions.
- **Promote collaboration** with peers and experts, locally and globally. Students develop the ability to work in teams, reconcile competing points of view, and communicate with relevant audiences. These collaborations bring the world into the classroom, foster cross-cultural communications and understanding, and allow students to broaden their vision of the future and their place in it. Connecting with experts can also promote entrepreneurialism, and increase students' awareness of career and training options.
- **Prepare students** for standards-based assessments while delivering rigorous experiences that activate each student's learning path.
- **Enable students** and teachers to build their success by creating personal learning communities.

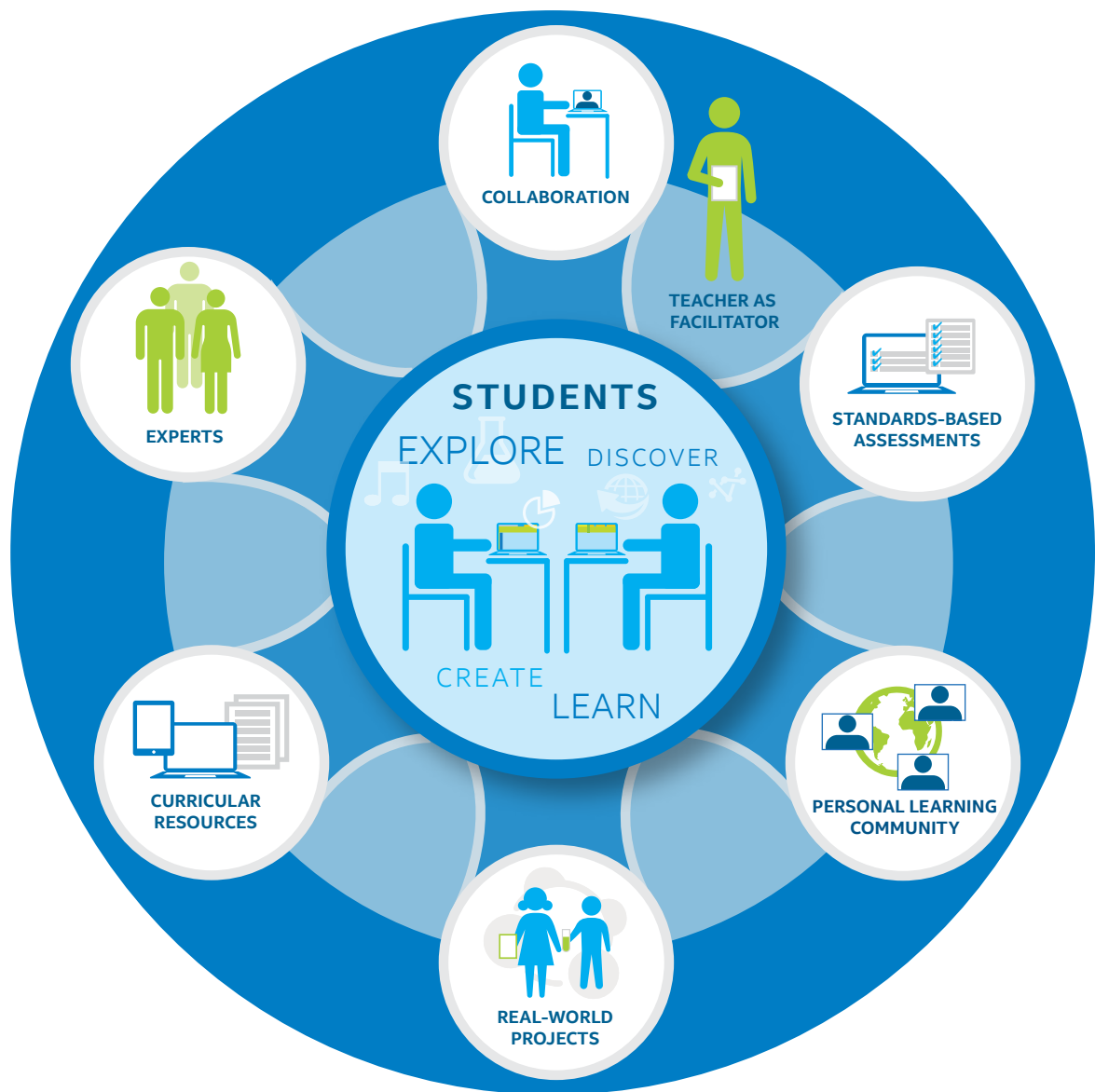


Figure 6-1. Student Use of Digital Resources to Explore, Discovery, Create, and Learn

Guided by skilled teachers, digital learning environments can help students drive their own learning, deepen their understanding, structure their knowledge, and grow as developing experts. **Students** can:

- **Conduct** learning activities that would otherwise be impossible or impractical, such as creating and interacting with a simulated climate model, or conducting virtual experiments without the need for expensive equipment and time-consuming setup
- **Use** virtual laboratories and educational gaming software to simulate, explore, and understand scientific concepts, solve challenging problems, and more
- **Engage** with complex text, identify key points, and use evidence to support a thesis
- **Conduct** virtual conversations and broadcast sessions with experts and peers
- **Participate** in virtual field trips
- **Learn** to filter and evaluate resources, develop the skills they will need as life-long learners
- **Access** learning resources when and where they need them

In a one-to-one environment with powerful mobile devices and high-quality digital resources, **teachers** can more easily:

- **Empower students** to learn anywhere and work more autonomously, whether individually, in small groups, or as a whole class
- **Analyze and understand** each student's progress toward mastery, and apply evidence-based teaching strategies that address individual learning styles, interests, pace of learning, degree of content mastery, and special requirements
- **Bring the world** into the classroom, having students use video conferencing to interview and collaborate with outside experts and partner schools
- **Extend learning** beyond the school's walls, managing student internships and community projects
- **Provide** innovative ways for students to demonstrate what they've learned
- **Activate** students to synthesize what they've learned and use higher-order thinking and creativity skills to build new content

Many digital resources provide practical benefits in addition to improving student learning. For example, teachers can:

- Use agile and up-to-date content compared to physical textbooks
- Deliver content in multiple languages
- Use productivity tools to more easily organize and manage courses, content, assessments, and other information

A literature review conducted by the United States Department of Education (DOE) found a range of pathways through which teachers can use digital resources to improve students' learning (see Table 6-1 for examples). The study notes that these improvements can occur at the same or lower cost than traditional methods, thus increasing educational productivity.

Using Digital Learning to Increase Educational Access and Effectiveness¹⁸

Methods	Examples
Broaden access to resources and experiences	<ul style="list-style-type: none"> • Enable students in rural areas and other underserved regions to access high-quality educational resources
Engage students in active learning	<ul style="list-style-type: none"> • Replace lectures with individual and group work such as online discussions and content that integrates formative assessments • Use digital simulations and visualizations to make abstract concepts easier to understand • Develop students' understanding of multiple perspectives through educational games
Provide individualized, differentiated instruction	<ul style="list-style-type: none"> • Use adaptive learning environments and diverse resources to meet each student's needs • Use features such as hypertext and multimedia to make content more understandable for a variety of students • Use online, formative assessments to give students immediate feedback that increases learning and helps them move through a learning progression more efficiently
Enable personalized learning	<ul style="list-style-type: none"> • Offer a "buffet" of resources that align with curriculum goals, enabling students to shape their learning paths to reflect their interests
Maximize teachers' and students' time	<ul style="list-style-type: none"> • Use learning management systems and other tools to more quickly create individualized, differentiated, and personalized educational experiences • Automate students' routine activities and use class time for activities that develop higher-order skills

Table 6-1 Summarized from US Department of Education, *Understanding the Implications of Online Learning for Educational Productivity*, 2012

Analysis conducted by Project RED¹⁹ aligns with the Department of Education's recommendations. Project RED found that one-to-one mobile technologies produce the greatest academic impact when teachers incorporate technology into core subjects every week, and use technology across the curriculum, including in intervention classes. High levels of success are also associated with having students use technology for online formative assessments at least weekly and for virtual field trips at least monthly.

New Learning Models

Teachers can incorporate digital platforms and resources into diverse learning models and teaching strategies that engage students in active learning, provide deeper learning experiences, and meet diverse student needs:

- **Personalized learning** occurs when the teacher crafts a learning program for each student's learning preferences, interests, and needs. Real-time input from embedded formative assessments are a key enabler of personalized elements, enabling teachers to base instruction on an in-depth understanding of the individual student's preparedness and ability.
- **Adaptive learning** is a subset of personalized learning that brings together the latest advances in cognitive psychology, learning theory, neuroscience, data analytics, and other fields. Adaptive educational software, running on the student's mobile device, analyzes student performance as the student interacts with the software. The software then modifies the learning pathway and adjusts the presentation of material dynamically. Adaptive learning is a rapidly evolving area.
- **Blended learning** combines traditional, face-to-face teaching and online learning, giving students the flexibility to study when and where they choose, on their own or with others, at the pace that meets their needs. Students typically use adaptive software that customizes the learning for the student's personalized learning profile.

- **Flipped or inverted classrooms** are a form of blended learning that reverses the typical sequence of instruction. Typically, teachers introduce a topic in class via a lecture, then have students practice and apply the lesson at home. With flipped instruction, students are introduced to new content via videos, simulations, educational games, or other digital media that they watch at home on their personal computing device. The next day, students use class time to explore the content and concepts further through individualized and small group activities, collaborative projects, and other hands-on activities. At home, students can review the content as much as they need to. In class, teachers can provide more differentiated guidance and students can get help from peers and teachers as they solve problems and deepen their understanding of new concepts.
- **Integrated studies** combine two or more subjects—such as science and literacy—to deepen students' knowledge of both subjects and strengthen their understanding of connections across subjects. Integrated studies can also increase students' motivation, creativity, and problem-solving skills. For example, in a science and literacy class, students not only conduct hands-on experiments, but also discuss and write about them.
- **Real-world, project-based learning** builds off students' natural curiosity. It focuses learning around real-world problems and authentic, inquiry-driven learning experiences. Effective project-based learning can increase retention of content, improve students' attitudes towards learning, and provide other benefits.²⁰ Technology can help teachers bring outside experts into the classroom via video conferences and other collaboration tools. It can also help teachers create “schools without walls,” establishing and managing internships in which students work meaningfully in organizations such as businesses, research centers, medical institutions, nonprofits, and cultural centers.

For an example of inquiry-driven, project-based learning, see *Case Study: Science Learning and Exploration in a Rural K-5 School*. For a research summary showing that powerful mobile devices provide benefits even in relatively simple usages, see *Case Study: San Luis, Argentina's All Kids Online Program*.

Choosing Content and Resources

Educators can choose from a wide and growing universe of digital resources, such as:

- Comprehensive instructional software
- Video and multimedia collections
- Educational games
- Experiments and simulations
- Online classes
- Tools for publishing, analyzing, collaborating, visualizing, and modeling
- Curriculum management tools
- Assessment tools

Digital resources contain a variety of capabilities that can meaningfully engage students in active learning. Useful features can include:

- Dynamic capabilities, from photos and graphs to interactive elements, animations, audio, music, simulations, gaming elements, pop-up explanations, and other multimedia capabilities
- Embedded tools such as calculators and spreadsheets
- Tools to enable content creation, communication, and collaboration, such as the ability to highlight and annotate text, create wikis, and edit video and graphics
- Embedded links to other content and experts

A learning management system (LMS) or content management system (CMS) adds to the digital environment by:

- Providing a single point of entry for teachers and others to create, share, and maintain content ranging from student blogs to course content
- Simplifying or automating tasks such as record-keeping, student assessments, and data analysis, improving educational efficiency and productivity
- Providing valuable data for evaluating the program's success

Both open source and proprietary solutions are available.

Resource selection works well as a collaborative process driven by educators and focusing on identifying flexible, robust, high-quality resources that align with curriculum and assessment standards. ICT participation on the selection teams can help facilitate technology adoption and identify any potential security, compatibility, or software management issues. Table 6-2 summarizes criteria to consider as you evaluate and select digital curriculum resources.

Selection Criteria for Digital Content, Tools, and Resources

Focus Area	Criteria
Curricular and assessment requirements	<ul style="list-style-type: none"> • Compatible with your curriculum objectives, assessment standards, pedagogic approaches, and devices • Supported by a range of content from nonprofit, open source, and commercial organizations • Grounded in research principles • Rigorous • Incorporates capabilities that keep students meaningfully engaged and add value to the learning experience • Uses visual and interactive elements for meaningful learning, not just for flash • Designed to inspire, engage, and challenge students • Supported by effective assessments • Provides built-in analytics and reports, if relevant
Usability	<ul style="list-style-type: none"> • Easy for teachers and students to use • Easy to customize and personalize to meet individual students learning styles, abilities, content mastery, and interests • Easy for teachers to present and disseminate content in multiple ways • Easy for teachers to extend content by reformatting, combining resources, modifying, etc. • Easy for teachers to identify and select content to meet curriculum requirements
Costs and management	<ul style="list-style-type: none"> • Easy to upgrade to newer versions • Available in multiple languages • Compatible with your budget and licensing model • Open source or affordable options for licensing or subscription services

Table 6-2

Next-Generation Assessment: New Ways to Improve Student Success

As curricular approaches evolve, assessments must advance to remain in alignment. Modern technologies offer powerful ways for students to demonstrate their progress toward mastery. New assessment methods also provide valuable, real-time data that students and teachers can use to adjust learning and teaching on the fly. These factors make assessment a cornerstone of the framework to transform education and improve student outcomes.

Based on a review of global studies, the Council of Chief State School Officers (CCSSO) concluded that effective assessment systems²²:

- Are grounded in standard-based curriculum and managed as part of an integrated approach that links standards, curriculum, assessment, pedagogy, and professional development
- Use a variety of measures to evaluate student performance on challenging tasks where they apply knowledge and skills
- Involve teachers closely in developing the assessment system
- Evaluate students and schools, i.e., they provide meaningful data for improving learning outcomes and accountability
- Give students and teachers valuable information they can use to improve learning
- Use ICT to provide immediate feedback, give students new ways to demonstrate their learning, and integrate information for analysis and increase accountability

Technology as an Enabler

In keeping with the shift to student-driven learning, assessments in the transformed environment involve students as active participants in assessment. Mobile devices and digital resources give students new ways to authentically and creatively express what they've learned, including both content mastery and the development of 21st century skills such as critical analysis and problem-solving.

Assessments delivered via digital content and tools can go beyond traditional multiple-choice exams. Students can create digital portfolios that include text, audio, video, and other elements. They can engage with computer-based simulations that put students into novel situations and ask them to solve problems, or create constructed responses to assess critical thinking and communication skills. Student self-assessments become a highly useful tool.

Secure platforms such as school web portals make it easier for students, teachers, and parents to review student progress and do collaborative goal-setting. This capability becomes especially important as students progress toward self-directed learning.

Data to Improve Instruction in Real Time: Formative Assessments

Technology-enabled formative assessments occur during instruction and give students and teachers immediate feedback they can use to quickly assess learning and improve outcomes. Formative assessments can provide a starting point for instruction (by showing what students know and identifying gaps and preconceptions). They can also show how well students are progressing toward their learning goals. Formative assessments and adaptive content can provide fine-grained information about student interests and developing skills to help teachers create and manage a personalized experience for each student.

Formative assessments also empower students as they advance from passive to active learning. Timely feedback from formative assessments enables students to identify their learning styles, understand their strengths and weaknesses, recognize gaps in their learning, and develop a plan for addressing them.

Aggregate Performance and Accountability: Standards-Based Summative Assessments

Summative assessments aim to determine mastery of material. They typically come at the end of a unit, course, or period of time. Summative assessments are important for:

- Understanding aggregate performance and comparing progress between groups of students
- Tracking student progress over time
- Ensuring accountability
- Inspiring stakeholders to raise expectations and increase investments in education

Standardized summative assessments, conducted nationally and globally, can help evaluate aggregate performance and identify shortfalls and areas for improvements. For example:

- OECD's PISA program offers its international benchmark testing of 15 year-olds every three years. PISA 2015 tests will introduce collaborative problem solving as a required area of skills assessment.
- The International Association for the Evaluation of Educational Achievement (IEA) offers two sets of tests around the world. The Trends in International Mathematics and Science Study (TIMSS) assesses the math and science skills of fourth and eighth grade students every four years. TIMSS Advanced assesses advanced mathematics and physics for students in their final year of secondary school. The Progress in International Reading Literacy Study (PIRLS) measures the reading comprehension skills of fourth graders.
- In the United States, the National Center for Education Statistics offers the National Assessment of Educational Progress (NAEP), the largest continuing, nationally representative assessment of student performance in mathematics, reading, science, writing, and other areas. In 2014, the NAEP added an assessment for technology and engineering literacy. Two consortia, the Partnership for Assessment of Readiness for College and Careers (PARCC) and the Smarter Balanced Assessment Consortium are developing online assessments that align with the Common Core State Standards.

Curriculum and Assessment Implementation Checklist

Key Tasks

- Modernize and align curricular frameworks and assessments to reflect your goals for student learning
- Choose and deploy a variety of content, tools, and resources that students and teachers can use to fulfill curriculum requirements in ways that match each student's learning style, interests, and academic goals
- Use formative and summative assessments to improve student outcomes

Steps to Success

Curriculum Planning and Development

- Ensure that your school or school system's curriculum align with the standards and benchmarks of your state, province or municipality, and nation. For those developing national and state/provincial standards, ensure teachers have the flexibility, professional development, and support to implement them in ways that meet each student's needs.
- Establish clear objectives that define the improvements you want to see in student learning and achievement.
- Based on needs assessments, analysis of your pedagogic base, and learning objectives, develop a framework of pedagogic strategies and a roadmap to transformative use of ICT resources. If necessary, start by incorporating ICT into existing strategies, then introduce newer instructional strategies to support broader change. Consider a variety of pedagogic approaches (flipped classroom, blended learning, project-based learning, etc.).
- Work collaboratively to determine how you will use digital resources and mobile devices to enhance new and existing teaching strategies.
- Develop a process for choosing content resources. Establish collaborative teams to identify high-quality content resources that support evolving curriculum and assessment standards as well as the pedagogic approaches you are focusing on. The teams should be driven by educators, but ICT staff should be involved to advise on any potential security and management issues.
- Enhance productivity by avoiding a chaotic software environment. A smaller number of robust, flexible platforms and applications will make it easier for teachers to develop expertise and share best practices. The environment is also more cost-effective to manage and support.

- Provide tools and training so teachers can create their own content. Establish portals or learning management/content management systems so teachers can share the resources they find and create. Choose an LMS/CMS system that provides detailed, usable data analytics and reporting capabilities to help you improve learning outcomes and evaluate your initiative's success.
- Collaborate with communities of practice, other districts, school systems, and education leaders to identify high-quality resources and practices.
- Develop a mix of open source, teacher-created, and publisher-created content that matches your curriculum goals, quality requirements, and budget resources.
- Collaborate with content developers, academics, and industry experts to accelerate the development and translation of high-quality curriculum and content resources.
- Educational software solutions are evolving rapidly, so continue to monitor new offerings.
- Provide professional learning opportunities for teachers to master new curricular frameworks, content resources, and methods of assessment.

Next-Generation Assessment

- Establish a multi-level framework of assessments that aligns with curriculum standards and pedagogy. Use a variety of assessment methods to evaluate student learning and provide continuous feedback that improves student outcomes. Focus more on learning outcomes and less on traditional metrics such as seat-time or the completion of specific content.
- Use technology to give students authentic ways to demonstrate learning, and support teachers in developing new ways to assess the results of collaborative and project-based learning.
- In planning changes to assessments, start with the learning outcomes you are trying to achieve. Work backward to develop metrics that indicate progress and allow you to measure success in meaningful ways. Use the results to increase system accountability and improve individual student learning.
- Avoid over-reliance on multiple-choice assessments, which don't capture students' progress in higher-level thinking.
- Engage students, teachers, parents, and the community to build consensus on the goals and benefits of new curricular and assessment approaches. Listen to and address any concerns.

Technology Planning

- Establish a team to determine device requirements for curriculum, content delivery, and assessment, as well as data security and device management. Include teachers, administrators, students, and ICT professionals.
- Create a digital learning environment that supports your curriculum requirements. In addition to mobile devices and content, consider equipment that adds value to the digital environment:
 - Software-based lab cameras, probeware, and other scientific equipment
 - Interactive whiteboards
 - Interactive response devices or software for immediate feedback, votes, quizzes, etc. for formative assessments
 - Digital cameras
 - Digital video equipment
 - Document cameras
 - Video displays in libraries, hallways, cafeterias and other common area to display common work or allow ad hoc collaboration and encourage creativity
- Establish a secure data system that can provide accurate longitudinal data on individual student progress as well as system-level data such as graduation and dropout rates.
- Develop a plan for managing the practical aspects of the digital environment, such as how teachers will collect students' work and submit grades.



CASE STUDY

Science Learning and Exploration in a Rural K-5 School

A K-5 public elementary school in the rural Appalachian highlands of Maryland, U.S.A., Crellin Elementary School was once an underachieving school with declining test scores. Today, Crellin students are some of the highest achievers in the state, and the school has earned national awards for student achievement, parent involvement, environmental leadership, character education, and more.

Technology plays an important role in supporting the curriculum objectives at Crellin. Teachers use mobile devices, science probes, and other digital resources to create authentic experiences that focus on student-centered, inquiry-driven, project-based learning. Projects often combine technology with math, science, social studies, research, writing, media and communication, and a healthy dose of creativity and fun.

“We view national and statewide standards as a floor, not a ceiling—they’re the bare minimum we strive for,” says Crellin’s principal, Dana McCauley. “We align with the state standards, but we also use real-life issues and students’ interests as focal points for research and problem-solving. We never use technology for its own sake. It’s always about helping our students be good people, critical thinkers, and problem solvers.”

Crellin teachers often collaborate to create all-school projects that last a full year. For a 2013/2014 agriculture project, teachers started from the Intel Seasoning the School Year unit and developed activities for each grade. Their preparations spanned the 2012/2013 school year and included acquiring lambs and chickens, working with the community to build a barn, and gaining certification to sell eggs.

Through the project, children learn to think like young scientists. They conduct inquiry-driven research, discovering the answers to questions such as what scents are more likely to draw coyotes and how various conditions affect chicken-laying behavior. Using mobile computers, probeware, and other software, the children gather data, analyze their results, and report their findings. They build their mathematical and communication skills, as well as creating spreadsheets and graphs to better explore, examine, and explain their data. They communicate with local and distant experts when it is relevant to do so, and often present their results to serious audiences—from local community organizations to college science and education classes.



Teachers use **digital resources** to **create** authentic experiences to focus on **student-centered learning**

Year-long science project—children become young scientists



CASE STUDY

San Luis, Argentina's All Kids Online Program

In developing nations and under-resourced school systems, textbooks and even paper can be scarce or shared resources. Mobile devices can add dramatic value in even when the devices are used with existing teaching strategies.

All Kids Online is part of a broad, 20-year initiative to transform the society and economy of the rural province of San Luis, Argentina. As in many Latin American schools, San Luis primary-school students previously relied on a copybook as combination textbook, workbook, study guide, notebook, and portfolio. The All Kids Online initiative is equipping all K-6 students in San Luis with an Intel® classmate PC, and all K-6 teachers with a laptop. The program also includes educational software, mentors, wireless broadband connectivity for homes and schools, and additional classroom technologies.

In a research project funded by Intel,²¹ researchers from the Education Development Center (EDC) observed classrooms at three San Luis primary schools. The research team found that because of All Kids Online, students' classmate PCs had replaced the copybooks and become a daily part of learning and teaching. Simply using the digital resources primarily as copybook replacements facilitated five important changes:

- Teachers managed the classroom more efficiently, giving them more time and allowing them to personalize resources to each student's level.
- Students and teachers could access a wider variety of educational resources, and each student had his or her own set of materials. Students spent more time on task.
- Students took ownership of their learning. They directed more of their own learning, controlling their own pace and taking on more activities as they were ready.
- Students received more frequent feedback. Even simple interactive worksheets helped learners practice and problem-solve, and kept them working longer. Teachers made better use of their time with students, and students could study outside of school.
- Students, teachers, and parents enjoyed more fluid communications, using tools such as chat and ad hoc video conferencing to ask questions or send homework reminders.

By making the teacher's job easier and more effective, these changes are leading to substantial improvements in student learning. They deliver immediate value while advancing San Luis schools toward deeper transformation.



All K-6 students equipped with PC; students **take ownership** of their **learning**

Teachers are more **effective**; immediate value in **student learning**



Citations

- 18 U.S. Department of Education, Office of Educational Technology, *Understanding the Implications of Online Learning for Educational Productivity*, 2012. <http://www2.ed.gov/about/offices/list/ost/technology/implications-online-learning.pdf>.
- 19 T. Greaves, J. Hayes, L. Wilson, M. Gielniak, and R.F. Peterson, *The Technology Factor: Nine Keys to Student Achievement and Cost-Effectiveness*, MDR 2010. <http://www.pearsonfoundation.org/great-learning/research-reports-and-surveys/project-red-the-technology-factor.html>.
- 20 Edutopia, <http://www.edutopia.org/pbl-research-learning-outcomes>.
- 21 Download the whitepaper *Highlighting Changes in the Classrooms of a Successful 1-to-1 Program in Rural Argentina: Case Studies of Todos los Chicos in la RED in San Luis* by Daniel Light and Elizabeth Pierson, May 23, 2012, at <http://www.intel.com/content/www/us/en/education/evaluations/changes-in-argentina-schools.html>
- 22 School Technology Action Report, *Doing More with Less: How Informed Assessment Practices Can Help*, 2012, eSchool News.

Resources

The following sites and organizations are leaders in developing innovative resources, tools, and/or perspectives on curriculum and assessment for 21st century learning.

- Achieve: <http://www.achieve.org/>
- Assessment and Teaching of 21st Century Skills (ATC21S): <http://atc21s.org/>
- Educurious: <http://educurious.org>
- Edutopia: <http://edutopia.org>
- International Society for Technology in Education (ISTE): <http://iste.org>
- Literacy Design Collaborative: <http://www.ldc.org/>
- Mathematics Design Collaborative: <http://www.mdc.org>
- National Assessment of Educational Progress: <http://nces.ed.gov/nationsreportcard/>
- New Pedagogies for Deep Learning, Global Partnership: <http://www.newpedagogies.info/>
- OECD's Personalising Education book is available for order at: <http://www.oecd.org/edu/school/personalisingeducation.htm>
- Partnership for 21st Century Skills: www.p21.org
- UNESCO ICT Competency Framework for Teachers Project: <http://www.unesco.org/new/en/unesco/themes/icts/teacher-education/unesco-ict-competency-framework-for-teachers/>
- Implementing the U.S. Common Core State Standards: <http://learningforward.org/docs/default-source/commoncore/professional-learning-plans.pdf>

Chapter 7 Information and Communications Technology: Platforms for Learning and Teaching



Chapter Introduction by Robert J. Gravina

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“Our goal is not just to engage students. We are building their fascination, excitement, and passion, and then getting out of the way.”

.....

As Jim Collins states in his book, *Good to Great*, technology is an accelerator. If technology is implemented well, with the right vision and plan, you will get better results faster. However, if you implement technology poorly, with no vision, the opposite will happen and you will get worse faster. At Poway Unified School District (PUSD), our classes with one-to-one computing outperform those with less technology, because of the entire environment. Technology is never just about the device. It's about providing professional development, in combination with other tools and content and support for the teachers to use technology to change the way they teach and the way students learn.

Our goal is not just to engage students. We are building their fascination, excitement, and passion, and then getting out of the way. We're always asking: Are we using all the capabilities that are at our disposal? Are we teaching differently? Professional development will always be the most effective thing you can do to improve learning.

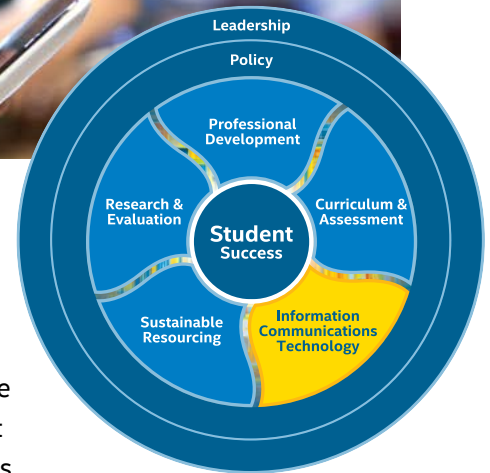
As technology becomes essential to teaching and learning, IT has to run more like a business. Schools can't afford to squander funds, so we need to build our project management expertise and increase the rate of success for technology projects. Because devices and networks must be completely reliable, IT teams need to use data to improve operations. We also need to think strategically about the mission of education—to look beyond running the hardware, and create new capabilities that help improve learning outcomes, ease of use, and collaboration.

I believe Big Data and its use for personalized learning is the next big technology on the horizon for school systems. Just as the private sector has embraced Big Data to increase profits, it is now time for education to do the same and to find ways to use all the data we collect on our students to develop personalized learning platforms. Teachers should always have the final input into what the student needs to learn and how they will learn it, but with the use of Big Data, we'll be able to provide teachers with much more information to help them guide each student's education. Educators will be able to do predictive analysis and if a student is developing problems, they can intervene to change the trajectory so that all students are college- and career-ready when they graduate.

Poway USD is preparing for this data era by building an adaptive learning platform—a recommendation engine that will suggest resources and tools based on the student's learning style, goals, and many different types of assessments. We're building a new school that will be organized around personalization and flexibility. Education is finally moving away from the 1925 model of learning.

Robert Gravina

Robert Gravina is a nationally acclaimed technology leader in the education field. At Poway USD, he is responsible for providing technology for 40,000 students and overseeing a user base of more than 100,000 students, teachers, parents, and administrators. He was named one of the Top 50 Innovative Educators by the Center for Digital Education, was a member of the California's Emerging Technology Council, and continues to represent educational technology on several other state and national advisory groups.



Essential Enablers

Information and communication technology (ICT) provides essential tools for educators to modernize learning, teaching, and assessment and increase student achievement. Effective eLearning environments combine mobile devices with high-quality education software, broadband Internet access, robust infrastructure, and secure cloud services to bring resources into the classroom and enable personalized learning experiences. Backed by appropriate infrastructure and guided by effective teachers, students use their mobile devices to:

- Work and learn within the school and throughout the community
- Access, use, and create a wide variety of media-rich content
- Read and interpret complex text, images, data, and media
- Collaborate with peers, local and global experts, and community members
- Conduct virtual experiments
- Demonstrate their learning through a variety of authentic methods in addition to exams

In addition to mobile technologies for students, ICT can improve educational results through:

- Productivity solutions that give teachers more time to work with students and allow schools to operate more efficiently
- Secure portals that extend the school day, improve communications between school and home, and empower parents to be active collaborators
- Collaboration technologies that help teachers reduce isolation and expand their expertise by participating in professional learning communities
- Advanced analytics tools that help decision-makers identify and extend evidence-based strategies
- Cost savings that can be applied to fund innovation

Investments in student devices deliver more value when students can use them throughout the school day and beyond, so a one-to-one ratio of students to devices is often recommended. Comparing schools with one-to-one computer deployment to those with a four-to-one ratio or higher, Project RED's research²³ found that the one-to-one schools were more likely to:

- Use a wide range of digital materials more (83 percent vs 46 percent)
- Use problem-based learning (75 percent vs 43 percent)
- Take control of their own learning (75 percent vs 40 percent)

As ICT becomes integral to everyday learning and teaching, school systems benefit from systematic approaches to selecting, deploying, and managing educational technologies and resources. This chapter covers:

- Choosing devices for learning and teaching, including tips for bring-your-own-device (BYOD) initiatives
- Securing and managing the environment
- Planning for the device life cycle
- Ensuring your infrastructure and data analytics solutions can meet rising demands
- Equipping ICT staff to support ICT's expanded role in 21st century learning and teaching

Choosing Devices for Learning, Teaching, and Assessment

Device choices for learning and teaching start from the desired outcomes and uses. Teachers need full-featured laptops to create lessons, design personalized learning experiences, assess student progress, collaborate with colleagues and experts, conduct their own professional learning, and evaluate new sources of data. Students can use a wider range of mobile devices depending on the grade level and the curricular and assessment requirements.

In addition to empowering learning and teaching, student devices must be managed efficiently and secured effectively. If they're not, large-scale device deployments can:

- Detract from learning and teaching by burdening students and teachers with management tasks, configuration details, and inconsistent performance
- Put the system's entire digital infrastructure at risk through virus attacks and other malicious activity
- Threaten the exposure of sensitive information, damaging the school system's reputation and risking legal penalties

To select devices that meet requirements for curriculum, assessment, management, and security, it's best to take a systematic, collaborative approach that builds on the school system's visioning and curriculum planning activities. A team that includes the school principal(s), students, teachers, ICT professionals, and other administrators can work together to:

- Develop device specifications that address the needs of all stakeholders
- Identify and evaluate devices that best meet the full range of requirements

If the budget supports it, a more saturated environment can enable students and teachers to use different devices depending on the tasks to be performed. In a mixed platform environment, schools can avoid chaos by selecting laptops, tablets, and other devices within a compatible architecture or operating system. For example, laptops, 2 in 1 devices, and tablets can serve as all-in-one learning platforms or in a compatible mix-and-match environment. The questions in Table 7-1 can help in device selection.

Practical Questions for Choosing Student Devices

Type of Requirements	Questions and Considerations
Performance	<ul style="list-style-type: none"> Can students use the device for serious computing? Does it provide responsive performance for interactive learning, media-rich applications, content creation, video conferencing, multi-tasking, and assessment? Will it support future applications and emerging capabilities such as adaptive software and real-time formative assessments? Can the device run virus scans, encryption software, and other security solutions without disrupting learning and teaching? Is the device reliable enough for everyday learning and teaching? Does the device meet global standards for energy consumption and environmentally sensitive materials?
Mobility	<ul style="list-style-type: none"> Is the device lightweight and easy to carry? Is it sturdy and rugged enough for student use? Does it come with a protective case? How long is the battery life? How easy is it to recharge, dock the device, or swap batteries?
Software and other capabilities	<ul style="list-style-type: none"> Does the platform support a wide range of student and teacher applications and resources, including open source solutions? Is it supported by mature classroom management solutions that let teachers easily view and interact with student devices? What educational software and equipment are included or available? How easy is it to integrate new capabilities—for example, to add devices such as digital microscopes for hands-on learning? What devices such as a camera, microphone, and speakers are built in?
Usability	<ul style="list-style-type: none"> Is the screen large enough and easily readable? Is it viewable in bright sunlight and dim lighting? Can students navigate through complex documents? Is the keyboard practical for serious work? What other data entry methods are supported—touch screen, handwriting, voice? Does the device meet assistive technology requirements? If not, how easily can it be modified?
Security, privacy, management, and the environment	<ul style="list-style-type: none"> Is the device supported by mature, enterprise-tested security and management solutions? How robust are the warranty, damage protection, and support arrangements? Is there expertise to support the operating system, including remote management and security technologies? Can you lock down the device for standardized tests (i.e., disable unrestricted Internet access, remote access, cameras, screen capture, Bluetooth connectivity, etc.)? Does the device meet national or international standards for environmental impact, use of sensitive materials, etc.?
Communications	<ul style="list-style-type: none"> What communication standards does the device support? Bluetooth, WiFi, 3G/4G, USB, etc? Can students work offline and synchronize their data when they connect to the network?
Cost	<ul style="list-style-type: none"> Will you need to buy equipment such as keyboards, headphones, and docking or recharging stations separately? How long can you reasonably expect the device to remain in service? What mid-cycle upgrades, if any, will you need to do? What is the total solution cost over the lifetime of the devices, including infrastructure impacts and software licensing costs?

Table 7-1

Bring Your Own Device (BYOD)

BYOD initiatives let students use personal laptops, tablets, and smartphones with educational software in the classrooms. By reducing or avoiding the school system's need to purchase mobile devices, BYOD can help stretch budget resources. However, a BYOD environment requires the same attention to policy, leadership, infrastructure support, curriculum development, assessment, professional development, and evaluation as a school-led technology initiative. In addition, BYOD raises concerns about equity, and the diversity of a BYOD environment adds complexities beyond those of a more controlled environment with school-owned devices. Table 7-2 summarizes some issues and potential remedies if you're considering BYOD.

Issues and Answers for BYOD

Issues	Background	Potential Remedies
Device suitability for mobile learning	<ul style="list-style-type: none"> Students' mobile devices may be too small or underpowered to provide a good response when using education applications or taking online tests Devices may not support required applications, or may support only a limited subset of the applications' capabilities 	<ul style="list-style-type: none"> Establish minimum requirements for screen size, CPU performance, battery life, software availability, browser speed, and other important criteria
Security	<ul style="list-style-type: none"> Student devices may lack security features, making it more difficult to protect data and ensure compliance with national and state policies designed to protect children The range of devices can make it hard to deploy security updates quickly and consistently 	<ul style="list-style-type: none"> Create a segmented network that keeps student devices separate from the network teachers and staff use Implement strong authentication procedures to ensure only legitimate users access the network Identify virus software and other security solutions for the range of devices students will bring Require that devices used for assessment can be locked down
Classroom management	<ul style="list-style-type: none"> Teachers must handle a diverse and challenging device environment 	<ul style="list-style-type: none"> Identify effective classroom management solutions that will work across the range of devices Provide professional support to help teachers address the challenges of managing a classroom with diverse devices
Network capacity	<ul style="list-style-type: none"> The network must handle a large number of devices running bandwidth-intensive applications simultaneously 	<ul style="list-style-type: none"> Be prepared for the demand, including the bandwidth to handle multimedia applications and peak loads at the start of the school day Work with local vendors and network specialists to plan for cost-effective network build-out
IT staff impact	<ul style="list-style-type: none"> IT teams must support a wide variety of devices, operating systems, and applications 	<ul style="list-style-type: none"> Assess your IT team's ability to support a BYOD environment. Plan for additional training and staff as needed Establish a secure portal to distribute educational software to student devices Monitor distribution so you can accurately determine usage
Equity	<ul style="list-style-type: none"> Not all families will have a suitable mobile device for their students or be able to purchase one 	<ul style="list-style-type: none"> Survey parent and student attitudes to identify and address any concerns before you start Establish a budget and procedures so students who don't have devices at home can acquire them

Table 7-2

Securing and Managing the Environment

Mobile device management (MDM) and security technologies can help ensure that confidential data remains private and technology investments are available to support learning and teaching every day. MDM solutions can help ICT staff manage devices remotely and maintain accurate inventory data, and efficient device management can help keep devices in good working order. Effective management strengthens security by enabling ICT staff to keep operating systems and applications up to date and to quickly install the latest security patches.

Strong security results from vigilance at every level and layer of the technology environment. This includes not only devices and device management, but also networks, firewalls, virus scans, data encryption, applications, and other security software. Security is a function of device capabilities (such as whether a mobile device can run encryption software if that is required). It also results from sound management processes and thoughtful efforts to educate students, teachers, parents, and others on effective security practices. Vendor management becomes more important to ensure that all vendors conform with relevant regulatory and school system requirements regarding data privacy and the appropriate use of data.

Standards-based assessments bring additional security requirements to ensure that tests are not tampered with, students do not collaborate inappropriately, and results are delivered securely to the testing agency. A security plan for standards-based assessment should consider:

- Device lockdown
- Bluetooth* pairing
- Key loggers and spyware
- Network breaches
- Malware
- Denial of service attack
- Student authentication and identification

Life Cycle Management and End-of-Life Planning

Life cycle management is important for gaining the full educational value of educational technology investments. Both educational effectiveness and lifetime total cost of ownership (TCO) are affected by how long you keep computers in service. The key is to plan for a realistic life cycle that matches your budget and ensures that mobile devices and other ICT solutions will still be effective learning tools during the latter half of their life span. For aging devices, the important questions are:

- Can the platform still provide good performance for the applications, tools, web sites, and usages that are important to learning and teaching?
- Can it run well-supported modern operating systems, security, and management tools? If not, keeping the devices in service may expose the systems and the network to unacceptable levels of risk.

Rapid technology advances can make it more cost-effective, energy-efficient, and educationally sound to replace aging devices and infrastructure than to keep them in service. As computers and devices age, consider whether they are starting to:

- Require costly and time-consuming upgrades
- Consume more power than newer equipment, driving utility costs up and creating an environmental burden
- Reduce performance, causing frustration and lost productivity for users
- Require more repairs, further draining user productivity and reducing the time support staff can spend on more important tasks
- Raise the exposure to security risks if virus patches and other security software are not kept up to date

When it's time to retire your technology products, many PC vendors offer trade-in, recycling, or other end-of-life programs. Organizations such as EPEAT evaluate computers and other electronic equipment to highlight those that consume less energy, avoid environmentally sensitive components, and follow other best practices. Purchasing EPEAT-registered products can help reduce the environmental impact of your technologies and make them easier to recycle and dispose of at the end of their life cycle. If older equipment is still usable, consider wiping the hard drive and then waterfaling it within the organization, donating it, or otherwise getting value from it.

Infrastructure

Scalable, sustainable infrastructure provides critical back-end capabilities to support teaching and learning and achieve program goals. Infrastructure may include a secure private cloud for resources available within the school system, as well as local infrastructure linked to resources available through public cloud services. Infrastructure must:

- Support the activities and content required for learning, teaching, assessment, professional development, and collaboration—from sophisticated simulation software to emerging data analytics solutions
- Be reliable and robust enough for school-wide, system-wide, or state-wide deployment
- Be flexible and scalable to accommodate rapid growth in the number and variety of devices and the use of new data sources, media-rich applications, advanced tools, online assessments, adaptive software, archival requirements, and other usages
- Provide performance and bandwidth for peak periods such as high-stakes tests and the start of day when all students may be getting onto the network

Networks

Bandwidth opens the world to students and teachers, and providing sufficient bandwidth is essential to gaining the full educational value of investments in mobile devices. If students and teachers have a poor experience accessing the network, or if you have to limit the use of media-rich applications because of inadequate bandwidth, you're also limiting the educational value of the devices and losing some of the potential return on investment.

Whether you issue school-provided devices or implement BYOD, you may need to make major upgrades to wired and wireless networks to ensure that students and teachers can connect from wherever they need to and accomplish what they need to. To strengthen security, implement a segmented network that helps protect the school system's internal resources from unauthorized access.

Servers, Storage, and Cloud Services

Modernizing and virtualizing the server and storage infrastructure is an important way to provide added capacity at an affordable cost. Virtualization makes it possible to dramatically consolidate older infrastructure, saving floor space, reducing energy costs, and increasing the efficiency, flexibility, and reliability of the ICT environment.

Cloud computing builds on virtualization's strengths, adding faster provisioning of services and enabling ICT to quickly meet changing educational requirements. Depending on available bandwidth and Internet connectivity, many school systems will want to follow the same route as businesses and government agencies, moving toward a secure private cloud for the school system or state, supplemented by public cloud resources and virtualized local servers.

Data Analytics: Holistic Information, Better Decisions

School systems, like other large enterprises, have vast quantities of data residing in a diverse set of databases and applications. These solutions can do an adequate job of collecting and reporting data, but because they exist in individual silos, they make it difficult to analyze patterns that emerge from a holistic view of the data. Often, they are difficult for anyone but experts to use easily.

A new generation of data solutions is helping turn data into valuable information for students, teachers, parents, and administrators. Data warehouse solutions can bring together data from diverse systems and present it in easy-to-understand dashboards. Newer, big data approaches use a distributed analytics framework with open source platforms such to reduce the costs and increase the flexibility and power of data analysis.

By offering stakeholders a secure, comprehensive, and role-appropriate view of relevant data, a well-designed data warehouse or distributed data analytics solution can facilitate more evidence-based decisions about student learning, school system performance, financial planning, and more.

Professional Development for ICT

Large-scale educational technology initiatives often require new skills and expertise for ICT professionals. Professional development for ICT personnel should address:

- Understanding ICT's role as an enabler for 21st century learning and teaching
- Working collaboratively with educators and other stakeholders to improve student outcomes
- Providing high levels of support so problems are remedied quickly and teachers can focus on teaching, not on configuring and managing devices
- Ensuring that devices, networks, and other infrastructure are robust enough to be an everyday, all-day part of the student learning environment
- Implementing and maintaining a secure environment, including robust security and privacy policies
- Working with vendors to ensure they comply with policies and procedures, particularly regarding data management and privacy
- Using performance data to improve ICT operations

ICT Implementation Checklist

Key Tasks

- Select and deploy mobile computing devices that meet education and institutional requirements.
- Modify infrastructure, security, management processes, and ICT staff training to support ICT's critical role in learning and teaching.

Steps to Success

Professional Development for ICT

- Ensure that all ICT staff understand their role in supporting learning and improving student outcomes.
- Conduct a needs assessment to identify new roles and responsibilities for technology coordinators, system administrators, network administrators, and other ICT staff.
- Create a menu of professional development activities so staff can develop needed skills. Aim for a blended environment of face-to-face and self-directed activities.

Device Selection

- Start with your learning and teaching objectives, and be systematic. Establish a team of students, teachers, administrators, and IT professionals to identify device requirements and evaluate available options.
- Develop device specifications that address curricular and assessment requirements for the grade level and subject matter, as well as the school system's security, privacy, and management requirements.
- Evaluate and rank a range of devices and operating systems to choose the best alignment with requirements. A small set of flexible device types will be easier for teachers to use and ICT teams to manage than an extremely diverse environment.
- Make sure devices will comfortably meet assessment requirements, but don't neglect the capabilities needed for learning and teaching.
- Work closely with the school system's financial experts to budget for technology costs, including TCO. For each device category, aim for a life span that aligns educational requirements with budget resources.
- Take a holistic look at total lifetime costs as you choose devices, since device choices can affect infrastructure and life cycle considerations. For example, tablets generally need to be replaced more frequently than enterprise-level laptops. Tablets may also bring additional expenditures for access points, software licenses, and accessories such as protective covers and keyboards.

Infrastructure

- Conduct a needs assessment to identify needed infrastructure upgrades and staffing impacts. Plan holistically for infrastructure expansion, keeping the focus on meeting educational requirements with the devices that have been chosen. Device strategies such as BYOD can require additional server and network capacity.
- Audit each building, including classrooms, hallways, and common areas, to ensure you have enough electrical capacity, charging or docking stations, printers, power supplies, and other elements in place. Upgrade as needed.
- Assess LAN, wireless network, and Internet connectivity to identify and eliminate potential bottlenecks. Make sure you understand the bandwidth requirements of standardized testing requirements for your state, province, country, or school system.
- Device categories vary in their wireless "reach," so plan your placement of access points carefully to ensure adequate coverage of classrooms, libraries, hallways, and other spaces.
- To strengthen security, establish separate or segmented networks for students and teachers.
- Develop a roadmap to transition the school system's infrastructure to a virtualized environment with secure, private cloud services. Supplement the infrastructure with public cloud services.
- Work with local businesses, nonprofits, and government organizations to extend broadband coverage across the community.

Security and Management

- Make sure you understand and educate stakeholders on state and national laws designed to protect children from inappropriate content, inappropriate disclosure or use of student data, and other matters related to security and privacy.
- Develop and implement security policies, technologies, and procedures, including network segmentation, firewalls, filtering software, and data encryption if necessary.
- Develop a plan for maintenance and support, including how you will handle software upgrades, security patches, and other device management tasks.
- To reduce security risks, avoid keeping devices and systems in service once the operating system is no longer supported.

Rollout

- Ensure that teachers have their equipment well ahead of students and know how they will use the technology to improve student outcomes.
- Think through the practical issues. Where will you store devices if students are not taking them home? How will you deal with theft, loss, and repairs?
- Train ICT staff on all aspects of the deployment. Do a practice run in advance.
- Have all available technical support staff and instructional technology specialists physically present and highly visible as the deployment begins.
- Do a phased rollout—by grades, classes, or schools, depending on the scale of your program.

Ongoing

- Stay abreast of new technologies and solutions.
- Be proactive. Look for ways ICT can add value to the learning environment and the school community.
- Identify the types of data stakeholders need in order to make better decisions about student learning, school system performance, budgeting, and other issues. Deploy next-generation data analytics solutions and dashboards to provide that information in secure, easy-to-understand formats. Use distributed analytics approaches to provide more flexible, cost-effective data analysis.

INSIGHT

Choosing Devices for K-12 Learning and Teaching

By Robert Moore, Founder and Chief Consultant, RJM Strategies, LLC
[@BobMEdTech](#)

When it comes to choosing devices for students, we need to be as systematic in our approach to technology as we are in planning curriculum instruction or facilities management. We can't just buy technology and plan to figure it out as we go.

The best place to start is with student outcomes. Get everyone talking about what student outcomes you're looking for and how you'll use the devices to help achieve them.

It's important to understand what students will do with the devices over the lifetime of the device and over the full range of courses students will take. What resources will students access in their research? How will they collaborate? What will they create? How will they demonstrate learning? What assessments will they take? And what new capabilities are coming that teachers will want to have them use?

These discussions should lead you to a list of requirements, and prepare you to evaluate devices and see what matches your criteria. These questions are important before you start doing any educational technology program, so you can make sure the devices are suitable for educational tasks.

Device decisions can have large and unintended impacts on learning and security. Before you purchase devices, develop a plan for how you will manage them, including tasks such as security and distributing software applications. Choose devices that can be managed by a central IT team, and help your team develop skills and procedures to manage them. You don't want device management tasks to fall on teachers and add to their workloads. Poor device choices can set the school system back 10 years in device management and create serious security risks.



"When it comes to choosing devices for students, we need to be as systematic in our approach to technology as we are in planning curriculum instruction or facilities management."

Bob Moore has more than 25 years in education technology, including two decades as a CIO of K-12 schools. At RJM Strategies, he works with schools, education organizations, nonprofit associations, and businesses as a strategist, advisor, and subject matter expert.

CASE STUDY

Poway Unified School District (PUSD), San Diego County, California, U.S.A.




Located in southern California, PUSD operates 37 schools and serves approximately 35,000 students.

PUSD is committed to preparing every student for college or careers, and the district's leaders view ICT as essential to fulfilling that commitment. The district combines strong central and distributed leadership, and individual schools are taking varied approaches to educational technology. Several schools are piloting one-to-one models with a range of different devices, and others are experimenting with BYOD programs. Principals and teachers have taken the lead in many cases, deciding together what grades and curricular approaches to target, and choosing devices accordingly.

All programs share a focus on evidence-based planning and a holistic approach to implementation. "Our one-to-one classes outperform our non-one-to-one classes by leaps and bounds, but what we're doing is much more than just giving kids laptops or tablets," says Robert J. Gravina, PUSD's chief information and technology officer. "It's a whole one-to-one environment, with interactive technologies, digital tools, and media. We're always looking at whether we're using all the technology that's at the teachers' fingertips—using it effectively and using it to teach differently. We focus very heavily on professional development, and on using the data we have available to better serve our students."

Learn more:

- PUSD Education Technology Plan, July 1, 2011 – June 30, 2016: https://www.powayusd.com/doc_library/it_PUSDTechPlan2011-2016.pdf
- *Getting a Great Head Start in Poway, CA*, by Ellen Ullman, August 13, 2013. <http://www.k12blueprint.com/content/getting-great-head-start-poway-ca>
- Watch a video about an educational technology initiative with kindergartners at PUSD: <http://www.intel.com/content/www/us/en/education/it-in-education/education-poway-unified-kindergarten-video.html>

		
37 schools 35,000 students	One-to-one environment, with interactive technologies	Focus on professional development to better serve our students

Citations

- 23 T. Greaves, J. Hayes, L. Wilson, M. Gielniak, and R. Peterson. *The Technology Factor: Nine Keys to Student Achievement and Cost-Effectiveness*, MDR 2010. <http://www.pearsonfoundation.org/great-learning/research-reports-and-surveys/project-red-the-technology-factor.html>.

Resources

- Intel® Education resources for ICT leaders: <http://www.intel.com/content/www/us/en/education/it-managers.html>
- EPEAT recommendations and ratings for K-12 education: http://www.epeat.net/wp-content/uploads/2013/10/EPEAT_K-12_One-Pager.pdf.
- K-12 Blueprint's Bring Your Own Device Toolkit: <http://www.k12blueprint.com/byod>

Chapter 8 Sustainable Resourcing: Consistent Funding for Long-Term Success



Chapter Introduction by Valerie Thompson

Chief Executive Officer
e-Learning Foundation
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“Sustainable resourcing for ICT is essential to enable transformation, improve educational outcomes, and reduce the attainment gap.”

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Sustainable resourcing for ICT is essential to enable transformation, improve educational outcomes, and reduce the attainment gap. Education budgets are under extreme pressure in most countries, so successful long-term resourcing requires careful financial planning.

While a few school systems may have a single source of funding, most must look to multiple sources. Since every school and school system is unique, the mix of funding sources will vary. Even programs that get an initial, single-source infusion of funds must ensure they plan what they will do when devices need to be replaced and new students join the school.

Fortunately, there is a plethora of funding sources, and by combining several sources together, schools can enable the transformation process. Funding can come from savings generated by the use of technology. It can come from school budgets or parent contributions, or from grants, special programs, or entitlements. You may be able to work with governments and secure tax relief. Since equity is so central to transformation, you may be able to draw from programs that provide extra funds to schools with a high number of the poorest families. Every school's approach is going to be different.

You have to budget successfully and take account of total cost of ownership. TCO is well established in the world of business, but it has not been applied and is not understood by most schools. So, learn about TCO, and look for tools and resources to help you calculate it. It's a big deal. In addition, make sure that the savings generated through ICT get reinvested into the ICT pot, and not siphoned off to fund other parts of the organization.

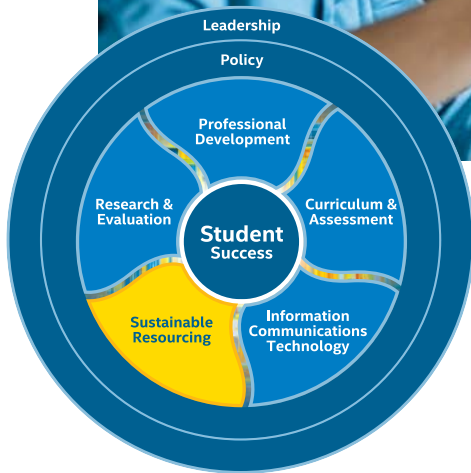
Parents are key allies in education transformation, and it is very reasonable to ask them to contribute something towards the cost of an individual mobile resource for their student. This must be presented in ways that make it highly affordable, for example, through small, regular payments supplemented by tax relief. External organizations may be able to handle the billing and payment collection for you.

Extending a school-based technology program outside the school walls is a powerful way to have more impact on equity and educational improvement. It is outside the classroom where the deep inequities are rooted, and where the real opportunity in terms of equity and educational improvement is to be had.

Making sure students can access the Internet and use their mobile devices at home helps ensure that technology actually reduces the digital divide rather than widening it. It also provides many more ways for schools to really engage with parents to the benefit of the child and the parents. You can e-mail them and send messages through the student's device. And you can design programs for the parents to work with their children. Simple approaches—putting the reading assignment on the mobile device allows the child to read it aloud to the parents, and then the parent can ask questions about the reading—can still be extremely powerful. These types of uses engage the parents and help them see how learning technology really works—not only how much fun it is, but also how successful it can be. It increases parent support for technology, and encourages parents to think about becoming learners again themselves. All these steps help ensure technology can be used to create meaningful and sustainable results.

Valerie Thompson

The e-Learning Foundation is a UK nonprofit organization that focuses on closing the achievement gap by helping schools and families provide computers, educational software, and Internet access to all school children, especially those from disadvantaged backgrounds and with special learning needs. As the foundation's CEO, Valerie Thompson has worked with schools in the United Kingdom and throughout Europe to establish sustainable learning technology programs. She was educated through the English state school system and has earned a degree in Animal Behavior from Cardiff University and an MBA from City University, London.



Sustainable Funding, Sustainable Results

Sustainable improvements in student outcomes require much more than a one-time infusion of technology. Teachers need ongoing time and resources for professional learning, curriculum modernization, lesson planning, and related tasks. Mobile devices must be replaced periodically. Infrastructure must be refreshed and expanded to

keep pace with rising demands. What may start as a technology project must become a permanent part of the learning environment, supported by consistent, sustainable funding.

Despite shortages of funds and long lists of competing priorities, ministries of education, state governments, and other school funding bodies must commit the resources necessary to integrate the costs of ICT-enabled learning into long-term operating budgets. Budgets must cover not only technology acquisition, support, maintenance, and device refresh, but also the ongoing costs of professional learning, curriculum development, content evaluation, and other aspects of transformation.

To make ICT a permanent part of learning, leaders must develop both a comprehensive budget and a practical approach to securing long-term funding. This chapter provides strategies and suggestions on:

- Holistic, values-based budget planning that addresses the introductory and ongoing costs of ICT as well as the broader aspects of a transformation-focused technology initiative
- Potential savings and cost-avoidance strategies
- Funding sources and strategies

Value-Based Resourcing

Successful educational technology initiatives focus on education—sustained improvements in student outcomes—and not on technology itself. Keeping that focus in mind throughout the budgeting and resourcing process can help education leaders create technology-enabled initiatives that achieve their promise, deliver ongoing value, and make wise use of scarce budget resources.

Budget planning starts from the initiative's goals, objectives, and requirements. Budgeting discussions should be cognizant of not only the costs of the initiative, but the potential value to be delivered. This value includes higher student achievement, increased equity, greater development of human capital, and other benefits discussed in Chapter 1. By adopting technology-facilitated strategies that enhance student learning and equity, schools can reduce costs, increase educational productivity, and deliver more educational value for the time students spend in school.

Focusing budget planning around the goals and objectives can guide stakeholders as they strive to balance budget priorities and trade-offs. Budget decisions, like other planning decisions, can be based on what will deliver the greatest educational and social value and achieve the goals of the initiative. For example:

- Decisions on what types of devices to purchase should be made not only on the basis of cost but on their suitability for learning and teaching.
- Investments in digital devices, digital content, and professional development generate more value when they are used extensively and effectively to improve student outcomes. Mobile technologies deliver more educational value when students use them as personal devices in a one-to-one device ratio throughout the day and evening, throughout the school and beyond. Policies that enable students to take their mobile devices home can also have a strong impact on equity, delivering benefits to the entire family.
- For communities and regions where equitable access is a concern, collaborative efforts to enable wireless connectivity from homes, libraries, and community centers can extend the ROI from investments in education transformation.

Effective budgeting, along with careful program planning and clear objectives, helps school systems achieve the full value from their investments in mobile devices, digital content, curriculum modernization, and professional development. Clear articulation of an initiative's goals and potential benefits is also vital when approaching potential funding sources. Finally, developing a sustainable budget demonstrates a long-term commitment to the use of educational technology. This can help inspire doubters to engage actively in mastering new approaches to technology-supported teaching and assessment.

Holistic, Longitudinal Budgeting

Effective budget planning is comprehensive along multiple dimensions. To avoid unanticipated expenses and achieve sustainable improvements in student learning, financial planning should address:

- **The full range of costs associated with technology.** This includes not simply initial technology acquisition, but also the total cost of ownership and operational costs of devices and infrastructure, software, operations, human capital, and licensing. Mobile devices will need to be replaced every few years, depending on the type of device.
- **All aspects of technology-enabled learning transformation.** Professional learning, curriculum, content, and other areas are essential to ensuring that mobile devices deliver their full educational value. While they may come under distinct budget categories, the budgeting process should recognize the importance of investing in these areas.
- **The long-term costs of technology-enabled education transformation.** Funds are needed to prepare for and launch a learning initiative, as well as to evolve and sustain it as it moves forward. Ongoing costs will also be incurred for modernizing and aligning curriculum and assessment, professional learning, developing and acquiring content, and using data analytics to improve school operations and student outcomes.

Many “technology” decisions have broad and sometimes subtle implications for costs, so budget planning should be holistic and comprehensive, and the school system’s financial planners should work closely and collaboratively with educators and ICT leaders. For example, device choices can influence costs well beyond the initial purchase or leasing price. If a mobile device has a lower purchase price but will require significant additional investments in replacement batteries, access points, and infrastructure, it’s important to know that as the budget is drawn up. Similarly, extensive use of external cloud services can alter the requirements for server and network infrastructure and ICT staffing. Having the school system’s financial experts involved in these decisions can help leaders evaluate trade-offs, avoid budget surprises, and achieve the greatest educational value with the available funds. Table 8-1 lists some major categories of costs.

Reducing the Costs of a Technology-Enabled Learning Initiative

A range of methods can help reduce the costs of an educational technology initiative and extend funding resources. Here are some approaches to consider:

- Use blended learning and online resources to reduce travel and other costs for professional development
- Develop local teachers as professional development experts who can act as mentors, coaches, and workshop presenters
- Support teachers, curriculum specialists, and other staff in creating content, tools, and resources

Cost Categories for a Learning-Focused ICT Initiative

Category	Investments
Student and teacher technology	Acquisition of student and teacher devices, including spare devices for backup
	Digital content, tools, and resources (developing and acquiring)
	Peripherals such as science probes, microscopes, cameras, etc., to meet instructional and assessment needs
	Docking and recharging stations, add-on keyboards, headphones, etc. if those are not provided with the devices and are needed for learning and teaching
	Paper, printer supplies, and other consumables
	Support and maintenance contracts
	Repairs and upgrades to student devices, including possible replacement batteries over the life of the devices
	Replacement devices and recycling or disposal of devices as they reach end-of-life
Infrastructure and facilities	Additions, repairs, and upgrades to network, server, and storage infrastructure, system software, cloud services, and peripherals such as printers and scanners
	Ongoing upgrades and refresh for infrastructure, system software, and peripherals, including end-of-life recycling or disposal
	Support and maintenance contracts
	Electrical upgrades to older facilities
	Ongoing utility costs
	Replacement infrastructure and end-of-life costs for infrastructure
Broader aspects of transformation	Initial and ongoing planning and community outreach
	Initial and ongoing work to modernize and align curriculum and assessments
	Acquiring and developing expertise using tools such as learning management systems, classroom management systems, human resources management systems, student information systems, and data analytics solutions
	Modifying the mix of staff to reflect changing needs for instructional technology specialists, technical support staff, and others
	Evaluating the program's effectiveness and identifying further changes

Table 8-1

- Reduce IT and teacher time requirements by choosing robust, well-supported devices and standardizing on a relatively small set of mobile platforms and devices
- Negotiate accidental damage protection and a comprehensive warranty as part of the device acquisition price
- Train high school students to handle routine repairs and troubleshooting
- Virtualize the school system's server, network, and storage infrastructure and move toward creating a secure private cloud
- Use public cloud services that meet high standards for data privacy and security
- Use open-source content, tools, and resources when they meet quality and curriculum standards rather than commercial products

Capturing Savings

Project RED research shows that well-implemented educational technology initiatives can contribute to cost savings and productivity improvements, particularly in a one-to-one environment.²⁴ Actions that may enable schools to avoid costs, improve educational productivity, and generate savings include:

- Replacing traditional textbooks with digital content
- Reducing materials costs and optimizing the use of teachers via blended learning, virtual learning, and distance learning
- Using online portals, social media, and e-mail instead of paper memos to reduce staff time and copy machine costs while enabling easier and more frequent communication among educators, students, and parents
- Conducting assessments online
- Implementing learning management and content management systems to save teachers time on tasks such as accessing content, organizing lesson plans, and recording grades
- Implementing modern systems for data warehousing, human resource management, and other administrative aspects of the school environment

Funding Strategies and Sources

Funding strategies and sources for educational technology vary around the world. Initiatives often start with an infusion of funds from state, national, regional, or local governments or from organizations devoted to improving education, driving economic growth, and increasing equity. Ministries of education may enlist support from ministries of commerce, technology, and others whose goals align with those of an education transformation initiative. Funding through programs such as Title I in the United States or the Pupil Premium in the United Kingdom, which allocate additional funds for schools with large numbers of low-income students, may be usable for ICT-enabled learning.

Grants and other financial support can be available from foundations, charities, and non-government organizations (NGOs) committed to education, equity, and economic progress. Public/private partnerships with businesses that are committed to the state, region, or community can also be valuable sources of support. See the sidebar, *Innovative Approaches to Funding: Portugal, Nigeria, Russia*, for examples of creative funding of technology-enabled transformation.

Purchasing Strategies

A variety of purchasing strategies offer flexible ways to acquire technology in ways that suit the needs of students, families, school systems, and education ministries.

- **Bundled service agreements** with technology, telecommunications companies, and other businesses make it possible to obtain needed equipment and services at a lower cost than if acquired separately.
- **Consortium buying** allows school systems to aggregate their purchasing power, with the potential to negotiate more favorable terms.
- **Leasing (or financing)** spreads the cost of devices, infrastructure, or other equipment over the products' lifetime. This avoids the need for a major capital acquisition as an initiative begins or as equipment reaches its end of life. Depending on the contract terms, the school system either owns the equipment outright at the end of the lease period, or returns the equipment to the vendor.
- **Family purchase programs** establish fees to cover the cost of buying a mobile device and educational software. To use this approach effectively, school systems must provide flexible payment plans and financing options for families. Government-backed loans and tax relief plans can help keep costs down for families.
- **Bring your own device (BYOD) initiatives** let students use their personal devices in the classroom. This can reduce the school system's costs for purchasing mobile devices, but does not reduce the need for funding of other aspects of education transformation, such as infrastructure, professional learning, and curriculum development. The resulting diversity of devices adds complexity in the classroom and often forces teachers to base their lessons on the capabilities of the least-capable devices. It also creates security and management challenges.

Sustainable Resourcing Implementation Checklist

Key Tasks

- Develop a comprehensive, long-term budget
- Secure resources to make technology-enabled learning a permanent part of the student experience and school culture

Steps to Success

Budgeting

- Develop a 7-10 year budget that covers all aspects of technology-enabled learning and teaching. Allocate time and resources for program planning, professional learning, policy review, curriculum and assessment, program evaluation, and continuous improvement.
- Ensure that financial leaders are closely involved in the overall project planning and device selection. This helps produce informed decisions that maximize educational value while preserving scarce budget resources. It also helps avoid budget surprises.
- Be transparent in your budget planning, and involve a range of stakeholders. This helps set expectations, build trust, and evaluate trade-offs.
- Work with policymakers to allow textbook funds to cover digital content and resources.

Cost Reduction and Savings

- In addition to equipping students with mobile devices, use blended learning, digital solutions, and modern software tools to improve educational productivity. Use technology to create savings opportunities and do things more effectively for less money. Look for opportunities to reallocate funds, avoid costs, and capture cost savings.
- In selecting learning technologies, aim for a smaller set of compatible devices rather than an extremely diverse environment. This can help you obtain better purchase rates, reduce ICT maintenance and support costs, and free teachers to focus on teaching.
- Determine the total solution cost for mobile devices. This should include total costs over the life span for the devices, including any optional equipment, mid-cycle upgrades, network and server build-out, service, and support.
- Centralize contract negotiations to obtain optimal terms on device costs. For long-term value, choose devices and infrastructure that:
 - Are robust and reliable, easy to use, and have the right features to support learners and teachers
 - Will optimize educational effectiveness and costs over their lifetime
 - Adhere to industry standards so they're easy to deploy and integrate with other solutions
 - Will require fewer mid-cycle upgrades and additional equipment over the lifetime of the device

Funding Sources

- Identify a mix of funding approaches that suit your community, municipality, province, state, or nation and can provide a sustainable basis for technology-enabled learning.
- Think broadly about potential funding sources. What organizations or businesses support the goals of your education initiative? Who will benefit from a better-educated workforce and citizenry? If a well-implemented initiative succeeds in increasing student achievement and developing human capital, it may ultimately drive economic growth and produce higher tax revenues from a better-educated citizenry. Cultivate those businesses and organizations as strategic allies.
- As you present your case to potential funders, focus on the learning value of ICT, not the technology itself. Be clear about how you will use digital technologies to improve student learning and equity and achieve the other goals. Align your proposal with the values and priorities of the funding organization. Use the funders' vocabulary.
- Show that you have a detailed plan for managing all aspects of transformation. Consider doing a small-scale pilot to demonstrate the ability to achieve meaningful results.
- Develop a research plan, and use it to show funders that you will be evaluating and analyzing your results to drive ongoing improvements.
- If any sources provide short-term funding, ensure you identify that early and plan how you will fill in. Develop contingency plans in case any funding sources are withdrawn. Look for ways to scale back in scope rather than stopping altogether.

Purchasing Strategies

- Consider leasing to spread ICT costs over an extended period. If you want the flexibility to use devices for less-demanding office tasks once they are no longer suitable for student use, negotiate a lease that lets you keep the equipment at the end of the lease cycle. Avoid contracts that require extensive maintenance operations before returning the machines.
- Consider collaborating with other school systems to increase your negotiating power with vendors. Consider bundled service agreements to reduce the cost of equipment and software.
- If you implement family purchase or BYOD programs, ensure you provide equitable means for all students to participate.



INSIGHT

Sustainability at a West London Academy

By Gary Kynaston, BEd, MA, NPQH, Headmaster, Hammersmith Academy, London

Hammersmith Academy is a non-denominational, all-ability, coeducational secondary school, and an exhilarating, inspiring, and creative place to learn. The academy was established in 2011, and is funded through the central government and two livery (charitable) companies: The Mercers Company and the Information Technologists' Company.

Our aim is to prepare students for the rigors of the 21st century work place. Hammersmith Academy provides a technology-rich education across the curriculum. We have a particular focus on Creative and Digital Media and Information Technology, but all faculties must plan for and demonstrate how digital technologies will support their learning goals and create independence with the students. We use a range of ICT to suit the educational requirements, including handheld devices, video editing suites, laptop trolleys, and a distance learning environment. We're also using new tools that give instant feedback on student performance and allow the teacher to be more focused on facilitation and individual improvement.

To create and fund technology, you have to start with a clear vision of what you want to be able to do with the technology. You need a sound financial model to show how expenditures on technology will provide the best education for the students and achieve real learning impact. It's vital to ensure you're getting value for money you spend.

Here are some specific suggestions:

- Start small, but think big. Develop a five-year vision, so that you're always thinking ahead, and plan for a two to three-year period. Add notional costing and justify it as part of the long-term approach.
- Develop a clear plan for how technology will be used in the curriculum, and avoid going for the fanciest platform. It's important to justify the use so that value for money can be assessed against results. We aim to be flexible and to try out different IT solutions to maximize learning, as well as insist on a level of governance and accountability that ensures sound justification in financial decisions.
- Work closely with teachers, parents, and students. Review progress with them two or three times a year, and listen to what they have to say. They will tell you if it is not working and provide good ideas for improvement.
- Budget carefully. People tend to focus on the front-end costs of the devices, but licensing costs can be major. You also need to plan for maintenance and replacement costs.
- Visit other schools, and create a "lessons learned" list. What pitfalls did they encounter and what would they do differently? How would they be more effective? How would they get more value for money?



Providing technology in school has become something we need to see in moral terms. We are disadvantaging students if we *don't* provide it. It's not the technology itself we are providing, but a real sense of access to the knowledge and skills in the learning function. Ask, how will technology empower students and staff? Which technology will enhance students' ability to learn and not just get good test results? These are the critical questions.



"To create and fund technology, you have to start from a clear vision of what you want to be able to do with the technology. You need a sound financial model to show how expenditures on technology will provide the best education for the students."

Appointed Head of the Hammersmith Academy in April 2010, Gary Kynaston led the design, built the team, and successfully opened the new academy in September 2011. The academy provides excellent standards of teaching, high quality access to IT, and supportive pastoral care. Since graduating from John Moores University in 1991, Kynaston has gained considerable experience in London schools. He completed, with distinction, an MA in Education Management in 1997 and NPQH in 2004.

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CASE STUDY

Innovative Approaches to Funding in Portugal, Nigeria, Russia

Portugal: National Leadership with Creative Self-Funding

The government of Portugal combined a national technology plan with comprehensive education transformation programs designed to increase digital literacy and social mobility. Portugal's comprehensive approach addresses policy modernization, professional development, digital curriculum, and mobile technology and broadband access for teachers and students.

Implementing a creative self-funding mechanism, the government arranged to source mobile devices from a Portuguese company and have software applications, peripheral equipment, and educational content produced locally. An export industry has developed to export the solutions to Latin America. The jobs created and taxes paid through Portugal's approach have funded the initiative and deepened its economic and social impact.



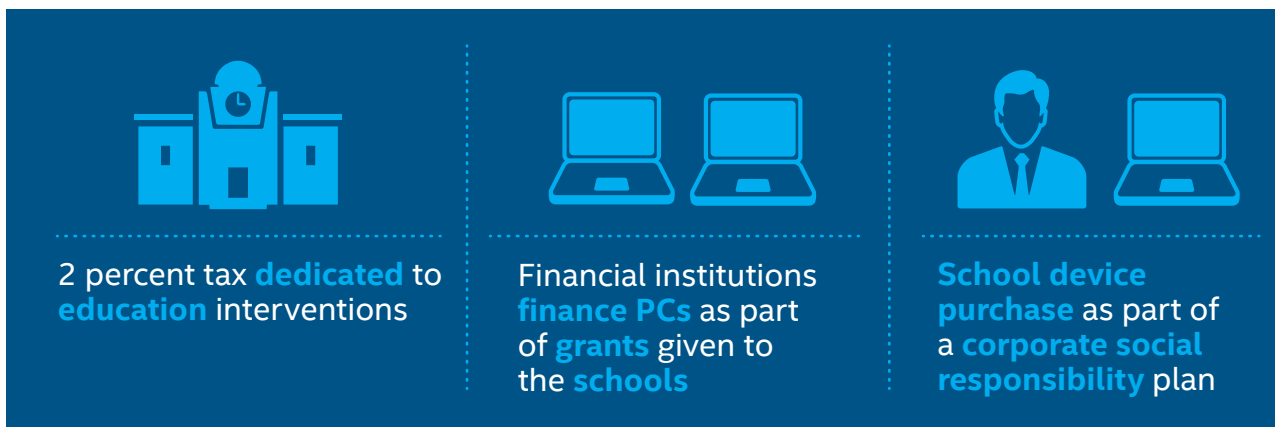
Nigeria: Taxing Business Profits to Fund Educational Technology for Public Schools

In Nigeria, the federal government funds educational technology for public schools from foundations and development agencies, such as the Education Trust Fund (a 2 percent tax levied on profits of companies registered in Nigeria, and dedicated to education interventions). Funds are given to the local Universal Basic Education (UBE) unit for educational materials. The UBE in turn seeds those funds to the schools through the state government, which complements the funds. Schools and local governments use these intervention funds to acquire ICT, but take responsibility for associated costs such as professional learning and wireless access setup.



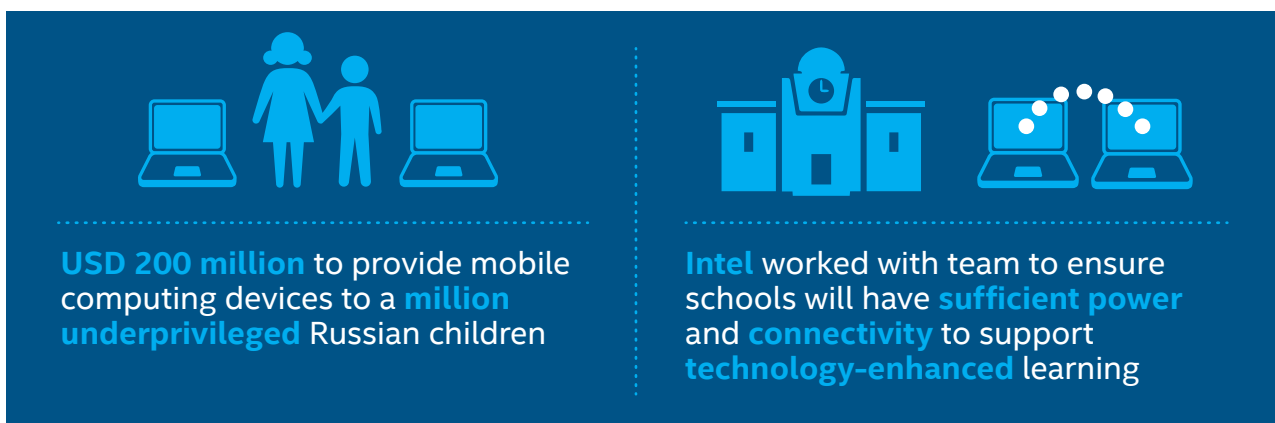
In some of Nigeria's affluent private schools, parent/teacher associations have adopted policies enabling each student to own his or her own education PC. Financial institutions finance the PCs as part of grants given to the schools but paid for by the individual parents, who in turn pay for the PC as part of tuition.

A teacher-assisted PC purchase program supports teachers through loans guaranteed by their regional education boards. A number of companies in Nigeria are also taking up school device purchase as part of their corporate social responsibility programs, which benefits the companies in turn by increasing the local rate of PC adoption.



Russia: The Power of Philanthropy

In a number of former Soviet Union countries, a few people have rapidly become very rich. Most of those billionaires have borne a certain degree of social responsibility, sometimes voluntarily, sometimes state-imposed. In one Russian program, the education system has enlisted philanthropic donors to help incorporate ICT into student learning. Oleg Deripaska, the principal owner of Rusal, the worlds' largest aluminum company, and one of the richest people in Russia, decided to invest more than USD 200 million over five years to provide mobile computing devices to a million underprivileged Russian children. Intel has worked with the Deripaska team to ensure that in addition to the mobile devices, schools will have sufficient power and connectivity to support technology-enhanced learning.



Citations

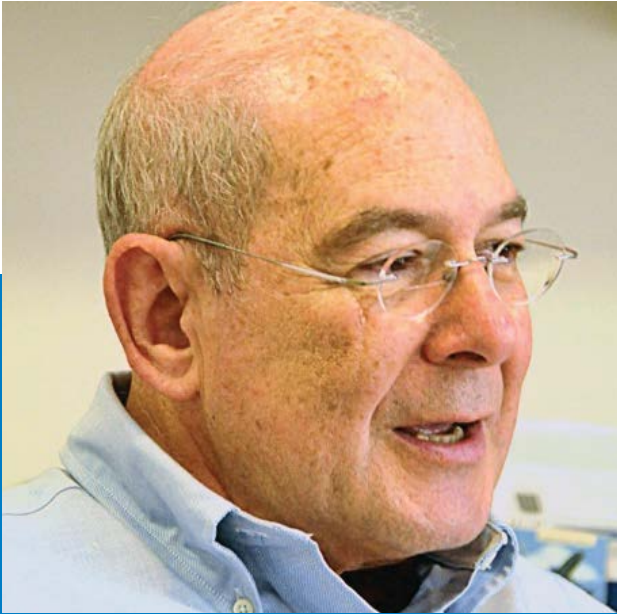
- 24 Project RED, *The Technology Factor: Nine Keys to Student Achievement and Cost-Effectiveness*, MDR 2010, at <http://www.pearsonfoundation.org/great-learning/research-reports-and-surveys/project-red-the-technology-factor.html>.

Resources

A number of nonprofit organizations have developed interactive tools and information sources to assist in budgeting for and funding technology-supported education transformation initiatives, including understanding TCO. Here are a few:

- Consortium of School Networking (COSN) worked with the consulting firm Gartner to create an interactive tool for calculating TCO: <http://www.cosn.org/tco>
- Edutopia provides information, resources, and tips for grant writing and other funding strategies: <http://www.edutopia.org/grant-information-resources-to-get-you-started>
- The London-based e-Learning Foundation offers consulting services and resources: <http://www.e-learningfoundation.com/>
- Funding resources and tools from Intel® Education: <http://www.intel.com/content/www/us/en/education/education-transformation/resourcing.html>
- The K-12 Blueprint offers a toolkit and extensive resources to assist in understanding costs and developing sustainable funding strategies: <http://www.k12blueprint.com/funding>
- The One-to-One Institute works with school systems to analyze current expenditures and recommend potential cost savings and asset redeployment that can help fund your program: <http://www.one-to-oneinstitute.org/index.php?services/financial-services/>
- Project RED's 1:1 Cost Savings Calculator, Costs Comparison Tool, and other resources are available at: <http://www.k12blueprint.com/content/new-tools-project-red>

Chapter 9 Research and Evaluation: Creating a Cycle of Improvement



Chapter Introduction by Saul Rockman

President, Rockman et al
[@rockmaneval](#)

“Research and evaluation often start with a desire to get evidence that you’re achieving great results, but the real need is often to understand which strategies led to success and which didn’t.”

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Research and evaluation often start with a desire to get evidence that you’re achieving great results, but the real need is often to understand which strategies led to success and which didn’t. This is information you can use to improve the program and see the changes continue and grow over time.

Research begins with questions—it takes you back to your vision of success. What are you trying to do? What are the best ways to do it? If you do it, what difference will it make? How will you know if you’ve made a difference?

Policymakers, administrators, teachers, and other stakeholders will have different research expectations depending on what decisions they are asked to make, so you’ll want to shape the questions to meet the needs of each set of stakeholders.

Planning research should involve input from both stakeholders and participants. Teachers are critical to success and should be part of the planning effort. These research planning discussions not only can provide ideas for research questions and implementation strategies, but also help enable teachers to own the impact and start to see the opportunities in the new initiative. Parents and other stakeholders can also provide valuable input on criteria.

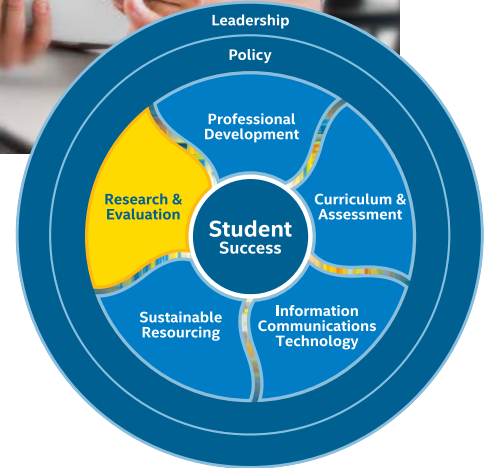
Once you have the questions, think about what data would be compelling and useful to answer them. Test scores are a safe way to judge program success, but they may not tell you anything useful. Look beyond test scores to identify criteria that are relevant to your goals and will give you a well-rounded portrayal of successes and challenges. Indicators of success might include student attendance, entries in the science fair, parent reports, and teacher satisfaction and retention. There are lots of ways of looking at important effects that provide meaningful insights into how a school works and how effective the program is.

How will you collect data if you're not already gathering it? Build on what you're already doing. Schools have a lot of information about disciplinary referrals, teacher turnover, grades, test scores, professional development, etc. There's no single methodology or common metric for all educational technology initiatives. It will depend, again, on your goals and your stakeholders' objectives.

Use the results to drive further progress. Consider issuing your "final" report at the midpoint. Schedule review sessions or community meetings to discuss findings and plan next steps. This can involve everyone in interpreting the data, planning what to do next, and creating a cycle of improvement.

Saul Rockman

Saul Rockman has spent more than 35 years as an evaluator, and is president of Rockman et al, an independent evaluation, research, and consulting firm that specializes in working with preschool, K-12, postsecondary, and adult education institutions. Rockman has a Master's Degree in Experimental Psychology from Case Western Reserve University and did doctoral work in Mass Communications and Research Design at Indiana University, Bloomington. Prior to establishing Rockman et al, he managed educational research for Apple.



Measuring and Building on Success

How well is your educational technology initiative working? Are you achieving the results you expected? If not, do you have clear evidence of what changes can move the initiative closer to its objectives?

Evaluating your initiative and conducting specific research activities can help provide valid, credible answers to these and other questions. Just as next-generation learners must identify meaningful data, analyze it, and respond appropriately, so next-generation learning cultures must model these same abilities through a commitment to rigorous, reliable, and valid research and evaluation of education programs.

Research and evaluation provide a basis to address any weaknesses, achieve your program goals, and extend your success. These processes and the resulting evidence can help you:

- Celebrate successes and identify areas where further investments, policy modifications, or other changes may be needed
- Identify effective approaches and resources
- Create a cycle of continuous improvement by increasing accountability and enabling a positive feedback loop
- Build capacity and skills to enhance evidence-based decision-making, budget planning, and resource allocation
- Secure continued funding by demonstrating success

Research and evaluation ideally begin with the initiative's early planning and goal-setting. They include the following steps and stages:

- Develop measurable goals
- Agree on meaningful indicators of progress toward goals
- Gather evidence of progress
- Use the results to build further success

Early Planning

The critical question for an educational technology initiative is: Are we improving learning outcomes and achieving the other goals we established? Answering this question requires first establishing how fully and how well the program has been implemented, and then agreeing on effective indicators of success. This latter step can be one of the most challenging of an educational technology initiative, but also one of the most meaningful. It takes you to the central matter of what success looks like, and it ideally starts with the program's initial goal-setting activities. Setting clear, measurable objectives for the initiative early in the planning process helps stakeholders:

- Gain clarity and agreement about the vision of success
- Establish evaluation criteria and success indicators during the initial stages
- Collect relevant data as the program proceeds, rather than attempting to justify the impact after the fact

Stakeholder Involvement

Research and evaluation should answer real-world questions and provide practical value to a wide range of stakeholders. Since different stakeholder groups will have different sets of questions and concerns, it is wise to involve groups such as teachers, students, administrators, policymakers, parents, and community members in the research planning. Working together, stakeholders can identify what data will:

- Show that the program is meeting its goals
- Show which aspects of the program are working well and help identify any weaknesses
- Empower stakeholders to make more evidence-based decisions about the program's next steps

Broad participation can:

- Strengthen the research and evaluation by incorporating multiple viewpoints and areas of interest
- Build consensus on how to assess the initiative and its progress
- Help identify valid indicators of the initiative's impact
- Increase the likelihood that recommendations resulting from the research will be embraced and acted upon
- Increase data literacy and build expertise in planning a research project, analyzing data, and interpreting results

Scope and Timing

A typical educational technology initiative unfolds over three to seven years or longer depending on its scope and scale. While equipping students with mobile technologies can be accomplished fairly quickly, changes to teaching practice, curriculum, and assessment will unfold and deepen over a longer period. Even within a single school system, different schools and teachers will advance at varying rates, depending on matters such as effective leadership, support, and culture. The impact on student learning, equity, and other goals can take even longer to become apparent, and often continues to build over a more extensive period time.

Viewing research and evaluation as an ongoing process reflects this reality. Ongoing research and evaluation can map to the major tasks of an educational technology initiative and provide valuable feedback to build continued success. Effective research and evaluation aims for:

- Continuous monitoring and reporting over the lifetime of the initiative and beyond
- Periodic evaluation and reporting at major milestones and intermediate stages
- Summative review(s) and reporting at the end
- Follow-up studies to see if results are sustained

A phased approach also helps clarify what you're actually evaluating. Have you simply provided laptops and tablets, or have you significantly advanced your school system in a holistic fashion across all aspects of the Intel® Education Transformation Model? Have teachers been provided with organized, ongoing professional learning, resources, and time to advance their teaching practice, or expected to figure it out for themselves? The research results will reflect those differences.

Evidence and Indicators of Success

A phased approach to research and evaluation enables stakeholders to align the research questions with the schedule and objectives as the initiative moves forward. These generally occur in three stages:

- **Implementation.** How well are we implementing the program?
- **Results.** How are learning and teaching changing?
- **Impact.** What improvements are we seeing in areas that are relevant to the goals of the initiative?

Discussion of the tasks and goals of each stage leads to further questions that the research can be designed to answer. In effective initiatives, this involves stakeholders working together to:

- Identify useful research questions targeted to the goals of the initiative
- Develop a set of success indicators that, taken together, will provide valid, relevant, and credible answers to the research questions

The examples in Tables 9.1 and 9.2 can provide a starting point for stakeholder discussions. Table 9.1 addresses aspects of program implementation, including not only technology basics, but also broader elements such as policy, curriculum, and assessment. Table 9.2 deals with longer-term results and impacts. Both tables suggest possible indicators of success for an educational technology initiative depending on its scope, scale, and focus.

Program Implementation. Examples of Goals, Questions, and Indicators of Success

Goal/Vision	Questions	Indicators of Success
Students and teachers have ubiquitous access to effective devices and infrastructure for learning and teaching	How well are we implementing our technology plan?	<ul style="list-style-type: none"> • Project adherence to the implementation schedule • Number and types of devices deployed • Sustainable funding plan in place, including a plan for device refresh
	Are devices suitable for learning and teaching?	<ul style="list-style-type: none"> • Number of times students use their mobile devices for learning per day, week, or class • Numbers of students and teachers reporting that their devices let them do what they need to do (create multi-media content, connect to the Internet, engage in video conferences, etc.) • Number of applications, tools, and content resources deployed • Number of students and teachers reporting they have the appropriate applications and software to support the curriculum • Number of students using the devices in new ways, not a substitute for pencil and paper in dedicated computer time • Number of students finding and using new, free resources from the web
	Have we created a secure, robust environment for learning and teaching?	<ul style="list-style-type: none"> • Number of access points deployed • Percent of school grounds covered by high-speed broadband • Number of times per week network bandwidth exceeds an established percent of peak load • Number of students, teachers, and staff trained on security best practices • Speed at which security patches and virus updates are applied to all student and teacher devices • Number and seriousness of security breaches • Number of cloud services acquired or created
The school system aligns to support full and effective use of digital resources	To what extent have we aligned policies, professional learning, curriculum, assessment, and the school culture to enable next-generation learning and teaching?	<ul style="list-style-type: none"> • Time spent on professional learning by teachers and principals • Number of teachers and principals rating professional learning activities as valuable or extremely valuable • Extent to which professional learning focuses on integrating technology into the curriculum, not on technology itself • Number of teachers active in effective online learning communities • Number of high-quality curriculum frameworks, digital content, applications, tools, and other resources developed or made available • Number of new assessment tasks designed • Number of policies reviewed and updated • Compliance with new policies
Teachers incorporate ICT into next-generation learning experiences	To what extent are learning and teaching practices changing? Is ICT being used in second-order usage models such as collaborative learning and personalized learning?	<ul style="list-style-type: none"> • Number and frequency of teachers integrating technology into their curriculum and teaching in new ways • Percentage of teachers who are enthusiastic about the change process and working toward second-order change • Number, frequency, and types of applications, digital resources, and usages by students and teachers per week or month • Number and complexity of project-based and inquiry-driven assignments • Percent of time students work independently or in small groups • Number of collaborations with external experts or peers • Number of times per month teachers use formative assessments • Number of teachers reporting use of flipped learning or other next-generation learning models • Frequency with which teachers use adaptive software and other tools to deliver a more personalized learning experience • Frequency of students using new methods to demonstrate 21st century transversal skills

Table 9-1

Results and Impact. Examples of Goals, Questions, and Indicators of Success

Goal/Vision	Questions	Indicators of Success
Students gain the skills, attitudes, and abilities to thrive in schools, careers, and society and achieve their fullest potential	How is the school culture changing? Are we engaging students in an active learning community?	<ul style="list-style-type: none"> Higher levels of student engagement Higher rates of attendance and graduation Fewer behavior problems More frequent communication with parents Greater parental involvement Higher teacher satisfaction
	What changes are we seeing in student outcomes?	<ul style="list-style-type: none"> Higher scores on tests of achievement in core academic subjects Higher scores on tests of STEM skills and achievement Higher scores on tests, artifacts, and project-based assessments demonstrating mastery of critical thinking, analysis, communication, and other 21st century transversal skills Higher graduation rates Fewer post-secondary students needing to take remedial courses
	Is our initiative helping to improve equity?	<ul style="list-style-type: none"> High-quality resources provided to all students Broadband extended to homes, libraries, community centers More girls enrolled in school More girls taking STEM classes Higher levels of achievement among the lowest quartile of students Smaller gaps in achievement between highest and lowest performing students Smaller gaps in achievement between genders, particularly in STEM subjects Higher graduation rates
	Are we having an impact on our economy and society?	<ul style="list-style-type: none"> Higher graduation rates More students, parents, employers, and professors saying graduates are well prepared Higher rates of youth employment Jobs growth in targeted segments

Table 9-2

Data Sources and Methods

Evaluation methods for an educational technology initiative should match the goals, objectives, and budget of the research and evaluation project. Most school systems are already producing a variety of data that can provide a starting point for data collection. This typically includes information such as:

- Grades
- Student results on standardized tests
- Enrollment and attendance
- Professional learning activities
- Equipment usage

The data produced by new management systems can provide additional insights. These include:

- Adaptive management software
- Learning management systems
- Classroom management software
- Human capital management systems
- School performance management systems

Additional data collection is important to supplement these systems and gain a fuller picture of an initiative's functioning, results, and impact. Quantitative survey of students, teachers, parents, and administrators are generally inexpensive, and the results are easy to analyze. Qualitative methods are often more difficult and time-consuming to analyze and draw conclusions from, but can provide valuable insights into how students and teachers are using digital resources and how student outcomes are changing as a result. Classroom observations and teacher reports can be especially useful in understanding changes in areas such as student engagement, collaboration, independent learning, and personalized learning. Qualitative methods can include:

- Interviews with students, teachers, and parents
- Surveys that elicit non-numerical responses
- Classrooms observations
- Analysis of sample lessons, student projects, and student artifacts
- Focus groups

Large-scale, long-term initiatives can gain a broader perspective through surveys of graduates, local employers, and post-secondary schools.

Action Research

In addition to formal evaluation, action research projects can provide evidence-based answers to real-world questions posed by teachers, curriculum specialists, and other education participants. In an action research project, teachers and other practitioners investigate elements of their own teaching practice or their students' learning. Action research projects can be valuable in understanding and furthering the impact of changes to learning and teaching. Action research also cultivates a "research mind," building analytic expertise and furthering the organization's ability to make evidence-based decisions.

Do You Need an Outside Evaluator?

For a large-scale initiative, a well-qualified external research partner can enhance objectivity and provide the benefit of experienced, independent viewpoints. An external collaborator can also contribute new perspectives and broader experiences. If your initiative is at all controversial or is occurring within a highly politicized environment, research conducted by an outside organization can give the results more credibility in the eyes of stakeholders. External evaluation may be required by some granting agencies or legislation. See *Case Study: Evaluating Progress and Furthering Success in Macedonia*, for a summary of a study conducted for the government of Macedonia by Intel® Education and SRI International.

If you decide to use an outside evaluator, look for consultants that take a customized approach designed for your goals and your stakeholders. Expect to stay closely involved, so the evaluation is collaborative and the results are meaningful to stakeholders.

Research and Evaluation Implementation Checklist

Key Tasks

- Develop a plan for evaluating the initiative's success and conducting research to establish evidence-based practices
- Use the results of your research and evaluation to improve your initiative, create a cycle of continuous improvement, and build capacity

Steps to Success

Planning the Research and Evaluation Project

- As soon as stakeholders have agreed upon goals for the overall initiative, establish a research and evaluation team and start to identify measurable metrics you can use to track progress. Establish your measurement and questioning strategies as you plan the initiative, not as an afterthought.
- To ensure the research and evaluation provides practical value, design research and evaluation activities to identify and answer the important questions and concerns of each stakeholder group. Use research and evaluation to:
 - Identify and celebrate successes
 - Identify areas for improvement and understand what changes are needed
 - Make funding decisions based on evidence of effective approaches
 - Build data literacy and a culture of improvement
- Invite all stakeholder groups, including students, into the research process. Participatory evaluation can produce a more robust study, develop consensus, and increase data literacy throughout the system.
- Plan an ongoing research project with periodic data collection, reporting, and discussion of results. Follow a logical path that ties back to your program objectives, and develop a roadmap of measurements that will be relevant as the program moves forward.
- Start with a zero-based budget for research and evaluation based on questions you want to answer.
- Consider working with an outside evaluation partner or research organization to gain an independent assessment of the initiative's results and impact. If you work with an evaluator, look for experienced, ethical, and collaborative organizations and individuals who are compatible with your school culture and attentive to your needs.

Creating a Measurement Plan and Collecting Data

- Build a measurement plan that will provide valid, relevant evidence to understand what aspects of the initiative are working well and design changes as needed.
- Match research evaluation methods to the intended purpose, and use a mix of data-gathering methods.
- As you create your measurement plan, determine what data you're already collecting and how you will gather data to support the new performance indicators. Use simpler, quantitative methods for most purposes, and save more expensive, qualitative methods for specific, narrowly defined purposes. If you use samples, make sure they are random.
- Use data from existing learning management, human resource management, and school performance management systems where possible. As you select these types of system, make sure they offer good data collection and reporting capabilities.
- To gauge long-term success at the state or national level, consider working with postsecondary schools and employers to gather data that can help you assess graduates' aggregate success.
- To reduce the costs of data gathering, consider training parent or student volunteers or university interns.
- Encourage interested educators to conduct action research projects.

Reporting and Using the Results

- Thoroughly review your findings with the planning team. Develop a roadmap and milestones to address any areas that need improvement.
- Communicate throughout the research and evaluation process with teachers, students, parents, community groups, funders, and other stakeholders. Engage in regular reviews and meetings, and create project newsletters, web sites, and other content to highlight ongoing activities and successes. Since different stakeholder groups have different research questions, modify your communications to match each group's interests and concerns.
- Use your research and evaluation to build support and secure continued funding. Demonstrate and communicate success, and enlist stakeholders in exploring and understanding results and planning for further advances.
- Build capacity by publishing and presenting at education conferences. This can reward and energize your own teachers and staff, and expand understanding of evidence-based instructional strategies.

CASE STUDY

Evaluating Progress and Furthering Success in Macedonia

In 2008, as part of its goal of creating a knowledge-based economy, the government of Macedonia committed to distribute Intel® Education solutions to all students in grades 1-3 and desktop computers to students in grades 4-8. The government specifically sought to increase the use of ICT in learning and teaching, and increase ICT literacy.

Macedonia faced numerous challenges in implementing its initiative, including lack of electrical and network infrastructure in many areas, and a low level of ICT readiness. Only slightly more than half of Macedonia's households possessed a computer, so many teachers were not familiar with using technology.

Intel was among the organizations serving as advisors to the program's planners, and Intel commissioned a study with local researchers to explore the initiative's successes and challenges. The researchers identified significant results after nearly three years:

- Macedonia's teachers are improving student outcomes by integrating ICT in primary school classrooms nationwide. All teachers interviewed for the research indicated that they use ICT in instruction at least once per week in all subjects.
- Professional development for teachers has scaled over time, leading to much higher rates of ICT literacy and greater use of ICT in classrooms.
- After initial delays, wireless Internet and intranet have been made available in all classrooms, including every lower primary classroom in the country.

The research team also identified areas for improvement. These include:

- Greater outreach to parents to emphasize that mobile devices are important learning tools
- Establishment of clear lines of oversight
- Continued focus on professional learning
- Continued development of educational content, applications, testing software, and other tools in the local languages

Note: This report is based on original data collection and analysis by local researchers in collaboration with Intel and SRI International (SRI). Original research conducted by Petar Nikoloski and Olga Samardzic. See Nikoloski and Samardzic, *Examining the Computer for Every Child Program in Macedonia*, 2012. <http://aare-aper2012.com.au/files/WERA-PAPER-Macedonia-Final.doc>.

Read the research summary: <http://www.intel.com/content/dam/www/program/education/us/en/documents/Intel%20Education%20Research%20Summary/intel-education-research-summary-macedonia-2012-eng-web.pdf>

Learn more about Intel's research protocol: <http://www.intel.com/content/www/us/en/education/evaluations/guide-to-monitoring-elearning-programs.html>

Resources

- Intel® Education offers research and evaluation toolkits that include models, protocols, and instruments. See <http://www.intel.com/content/www/us/en/education/education-transformation/research-and-evaluation.html> and <http://www.intel.com/content/www/us/en/education/evaluations/solutions-for-leaders.html>
- Edutopia identifies resources for evaluating education research and includes reports summarizing the research evidence regarding integrated studies, project-based learning, and social and emotional learning: <http://www.edutopia.org/research-resources>
- Michael and Susan Dell Foundation provides resources relating to performance-driven education: <http://www.msdf.org/programs/urban-education/initiatives/united-states/performance-driven-education/>
- OECD brings together data on how countries are improving quality and equity in their education systems: <http://gpseducation.oecd.org/Home>
- US Department of Education's What Works Clearinghouse maintains a database of studies on the effectiveness of educational programs, practices, and policies. WWC also publishes practice and intervention guides and reviews of individual studies. See <http://ies.ed.gov/ncee/wwc/>.

Chapter 10 Conclusion: Innovating Together



Chapter Introduction by Brian Lewis

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“Education must continue to innovate. The rapid pace of global change means we can’t avoid it. As educators and education leaders, we have to empower students to succeed in and create a world we can’t anticipate.”

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E ducation must continue to innovate. The rapid pace of global change means we can’t avoid it. As educators and education leaders, we have to empower students to succeed in and create a world we can’t anticipate. We do that by creating different pathways for student success, equipping and empowering students to embrace a constantly evolving future, and enabling them to become self-generated, student-driven learners. We drive equal access to technology and high-speed communications for every student, urban and rural, around the world. We use ICT to help teachers provide personalized, differentiated instruction so each child can succeed.

There's no magic to what we're after. We're simply trying to do our best to provide equitable, thoughtful, meaningful opportunities to all learners in a landscape of continual evolution.

Of course, change is hard, and deep change in education is harder. The good news is that we're getting better at it. We've seen enough successes that we're learning much more about how to do deep, serious innovation in education. We're broadening not only the definition of student success, but our understanding of how to achieve it, and we will continue to do so.

How do we improve our ability to innovate in education?

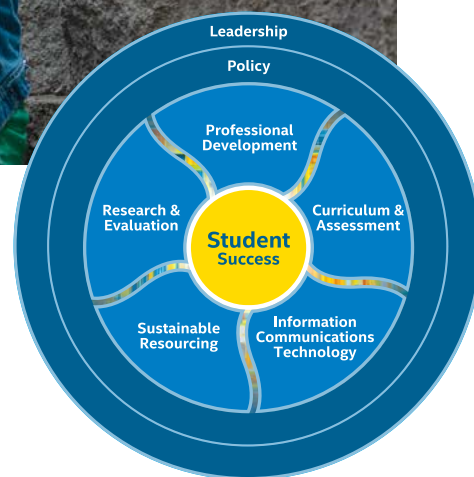
- We accept that the pace of change in our world is going to continue and education will continue to evolve—probably faster than ever. The school culture can set a powerful example of lifelong learning to deal with change and uncertainty.
- We create non-punitive cultures that value the learnings from—and can move on from—mistakes. If we're not making mistakes, we're not innovating. We need to make it safe to acknowledge what we don't know, living up to our promise to be and to support one another as lifelong learners.
- We promote collaboration. We need to continue the evolution from traditional teacher isolation to collegial support. All of us in education are going to need vibrant, ongoing professional development, as well as an environment that encourages us to learn from and share with peers.

The Intel transformation model provides a powerful framework that highlights the need for comprehensive planning, including governance, policies, and resources for professional development, curriculum resources, infrastructure, and other elements. It parallels ISTE's approach, as well as the foundational nature of the ISTE Standards for the effective engagement of technology in education.

Use these models as you move forward, and don't let the pressure to provide technology push you into premature deployment, before you have a solid plan for how you're going to use it to support local learning goals. Bring all stakeholders to the table early so everyone understands how technology connects to learning goals and outputs and can contribute their expertise. Aim for transparency, and share what works. A comprehensive approach and a culture of sharing can help us all succeed without feeling that we're each reinventing the wheel in isolation. The stakes are too high to not collaborate for shared success!

Brian Lewis

As CEO of ISTE, Brian Lewis heads a premier nonprofit organization serving educators and education leaders committed to empowering learners in a connected world. Brian has held leadership positions in both the public and private sectors, including serving as an elected school board member and the chief strategy officer and interim CEO for the National Board for Professional Teaching Standards (NBPTS). Brian holds a Master's in Communication Studies from California State University, Sacramento, and a Bachelor's in Mass Communications from the University of California, Davis.



Transformation is a process, not a destination. It requires ongoing innovation and systemic change. This work is complex and challenging, necessary and unavoidable. It's also exciting—and there are clear best practices that can guide you to success.

The *Transforming Education for the Next Generation Guidebook* has summarized these practices, including many lessons that have emerged from Intel's work with more than 10 million students and teachers in more than 100 countries. By using this guidebook and the Intel® Education Transformation Model, forward-looking school leaders can create technology-enabled learning initiatives that improve learning outcomes, increase equity, and deliver a strong educational return on ICT investments. These transformative initiatives can position communities, municipalities, states, provinces, and nations to innovate, grow, and thrive.

To highlight some of the most important practices:

- **Start with a vision.** Reimagine what's possible. Explore how you can use mobile technologies and digital resources to help achieve your goals, and identify changes you'll need to make throughout the system to support the full and effective use of ICT.
- **Focus on learning outcomes and equity, not technology.** Mobile devices, new data sources, and instant feedback mechanisms can empower students and teachers with powerful capabilities, but their use must be guided by highly qualified teachers.
- **Take a holistic approach.** Use frameworks such as the Intel Education Transformation Model and the ISTE NETS models to help guide systemic change. Develop a detailed roadmap for changes to professional learning, curriculum and assessment, leadership, policies, sustainable resourcing strategies, and ongoing program evaluation.
- **Empower teachers to use technology in meaningful ways.** Look beyond compliance-focused ICT training. Instead, create a safe environment that inspires, informs, coaches, incentivizes, supports, and listens to teachers. Provide flexible professional learning opportunities for teachers, principals, and other school leaders. Model a commitment to lifelong learning for all members of the school community.

- **Work with stakeholders at every stage.** Develop collaborative, multi-stakeholder processes for tasks such as choosing devices, designing curriculum, aligning assessment, and evaluating the program. Diverse input leads to better planning and greater buy-in. Include students when possible—it's their education and their future.
- **Increase the impact from your investments** in technology by enabling students to take their devices home and involving parents in their students' learning. Collaborate with public and private-sector organizations to ensure students can access educational resources from home, libraries, and community centers.
- **Learn what works, and follow evidence-based strategies.** Explore OECD's research to see what you can learn from countries that are improving their learning outcomes. Take advantage of case studies and research papers from Intel and many other sources. Talk with peers and colleagues, and visit schools that are having success. Each nation, state, municipality, province, and community is unique, but many challenges are universal, and many solutions are transferrable.
- **Share your successes and failures.** What worked? What didn't? You can expand your own success, build capacity throughout the system, and help others succeed by increasing global recognition of effective strategies.
- **Continue to improve.** Monitor and evaluate the effectiveness of your programs and continue to refine and improve them. Compare your school system to international benchmarks.

Resources

Intel® Education provides technologies, solutions, tools, case studies, and other resources to support education transformation based on global best practices. To learn more:

- Overview: <http://www.intel.com/content/www/us/en/education/k12/k12-educators.html>
- For school leaders: <http://www.intel.com/content/www/us/en/education/evaluations/solutions-for-leaders.html>
- For teachers: <http://www.intel.com/content/www/us/en/education/k12/teachers.html>
- For ICT professionals: <https://www.ssl.intel.com/content/www/us/en/education/solutions/technology-to-classroom.html>
- Intel® Education Technology Adviser: <http://www.intel.com/content/www/us/en/education/it-in-education/intel-and-education-elearning-technology.html>

Many other organizations offer resources such as whitepapers, research reports, case studies, learning networks, financial planning models, and customized consulting services.

- OECD's Education GPS site brings together data on how countries are working to improve quality and equity in their education systems, including policies and outcomes: <http://gpseducation.oecd.org/Home>. For an overview of OECD Education, see: <http://www.oecd.org/edu/>.
- Consortium of School Networking (COSN): <http://www.cosn.org/>
- Council of Chief State School Officers: <http://www.ccsso.org/>
- Educurious: <http://educurious.org>
- Edutopia: www.edutopia.org
- E-Learning Foundation (London): www.e-learningfoundation.com
- International Society for Technology in Education (ISTE): <http://www.iste.org>
- Learning Links Foundation: <http://www.learninglinksindia.org>
- New Pedagogies for Deep Learning Global Partnership: www.newpedagogies.info
- One-to-One Institute: <http://www.one-to-oneinstitute.org/>
- Project RED community: <http://www.projectred.org>



