INNOVATE 2 INNOVATION

An Assessment of California's
Innovation Ecosystem

Phase II Report
EDUCATION ACTION TEAM

DIGITALLY ENHANCED EDUCATION:
Innovation for Our Ultimate
Resource - People

Prepared for the California Legislature
August 2011

Prepared by
California Council on Science and Technology

Executive Summary
Creating and Sustaining a 21st Century Learning Environment

The digital age has affected students' learning, memory, attention and social relationships. Children and youth of the digital generation are defined by their technology and media use, their love of social connectivity through electronic communication, and their need to multitask. They enjoy access to unprecedented volumes of news and information around the clock. Some educators have embraced the possibilities inherent in these technologies, transforming teaching and catalyzing education reform with tools such as educational video games and virtual tutors. However these efforts have been largely experimental, and economic realities and regulatory constraints have hindered serious attempts to make widespread changes.

A fundamental premise for this i2i report on digitally enhanced education is an acceptance that the digital age has particularly far-reaching implications for education, and that California needs to implement a 21st century learning environment that reflects the ubiquitous presence of technology and fully utilizes the tools, competencies, and innovation that have become part and parcel of daily life.

Transforming California's 20th century education system into a 21st century learning environment is not just a question of following cultural trends, but rather a matter of ensuring sustainable economic development in California and enhancing our global security. The task at hand is to align the human capital (students) with the experts (teachers) through state-of-the-art tools (technology).

As a component of the overall i2i project requested by the Legislature, The California Council on Science and Technology (CCST) has facilitated several discussions around the state and explored educational opportunities in new technologies. An Education Action Team was convened, charged with developing recommendations to more comprehensively alter the approaches to educate California's future workforce.

The Legislature's charge to look at California's innovation ecosystem is a valuable chance to look at different educational models: the opportunity should not be squandered. Through active public-private partnerships, a new, innovative approach could leverage the substantial technology base in California to greatly improve educational opportunities, resulting in a new, transformative approach that could make relevant worker training and advanced education accessible to all Californians. Investing in digitally enhanced education is, in effect, a strategy which uses California's formidable technological expertise to "reboot" the state's education system for the digital native generation, the state's future workforce. Through a variety of engagements across California over the past year (including roundtables and conferences), CCST produced a Phase I report that formulated two primary goals for the education component of the i2i project:

- Characterize the new digitally enhanced learning environment and identify the processes and associated products that will become fundamental parts if the i2i learning initiative.

- Catalyze the creation of new public-private partnerships able and willing to go to the next stage of implementation.

This Phase II report is designed to build on the earlier Phase I findings and inform and guide decision makers in California in responding to key questions such as:

1. What would education in K-12, two-year colleges and other institutions of higher education look like if they were to be digitally designed from the ground up?

2. How can the rapidly emerging technologies of immersive learning and 3D-Internet-based learning, coupled with high-speed communications, be used as core enablers?

3. How can the integration of technology in education more effectively, and measurably, educate and train students and a workforce with varying needs?

4. What efficiency and effectiveness improvements could be gained in a time of constrained budgets to ensure the highest-quality education at all levels and reach the most students?

There are no lack of ideas and best practices that, if deployed, could effect significant change. However one of the real challenges is to navigate the fine line between a consistent, systemic approach that reaches throughout the state's large educational system, and flexible local implementation capable of adapting to and accommodating the range of needs throughout the state.

CCST proposes that California's 21st century learning environment be grounded in digital learning, transforming schools into "incubators of learning and innovation." The skills and competencies gained in these learning environments would be directly applicable to the workplace. These incubators would be characterized by student access to technology; personalized learning; use of on-line content; assessment and accountability; and an overall learning environment sensitive to and grounded in the digital age.

In order to achieve this aspirational 21st century learning environment, specific steps would need be taken. The process of creating these incubators rests on four foundational pillars:

1. The Classroom Environment: California must redefine the classroom as a mobile learning environment (access any time, any place) in which students have an active role in their learning experience, resulting in more student engagement. Islands of best practices for this approach have emerged throughout the state; these need to be fostered and replicated.

2. The Teacher: California must foster an innovative learning environment where teachers are working alongside instead of in front of their students in a collaborative environment, with more opportunities for students to work at their own pace. The California Teachers Advisory Council (Cal TAC) is a key example of the best and brightest teachers leading in this new learning environment model.

3. The Institutional Infrastructure: California must ensure that the infrastructure in these learning environments keeps pace with the digital world by ensuring that students and teachers have ready access to digital learning tools and policies that support their use. California State University is an example of a teacher preparation system that has been connecting digital learning infrastructure to teacher training and development.

4. The Partnerships: California must encourage and enhance public-private partnerships, since they are a critical component for the development and sustainability of the envisioned 21st century learning ecosystems. TechNet, CSL-Net and the California Emerging Technology Fund are among the many organizations leading this charge for communities of innovative learning through digital learning.

Creating and sustaining a 21st century learning environment for California's students and teachers based upon these four pillars will require a strategic approach that focuses on eliminating a variety of barriers. Some of these will require policy and/or legislative initiatives, while others can be implemented locally, provided that leaders receive suitable support and encouragement. Some logistical barriers can be addressed through public-private partnerships. As California is the global leader in innovative digital technologies, new partnerships between educators and industry should be strongly encouraged that both create technology for adoption in California schools, and provide new markets and new jobs for Californians.

In order to address these barriers in a systematic way, CCST recommends that the state establish a California Education Innovation Consortium to promote digitally enhanced K-16 education.

This Consortium would be comprised of stakeholders from K-16 education, business, government, NGOs, among others and be charged to address the following goals:

ACCESS

- Every child in the state of California should have access to broadband capability.

- Every student is permitted and encouraged to use personal digital tools in the classroom to complement his or her education.

EDUCATION CODE

- The existing Education Code in California contains a number of provisions that are conducive to digitally enhanced education efforts and they should be implemented to the fullest extent possible in a timely and deliberate manner. Language in the Code that hinders the adoption of digital education should be identified and removed.

STANDARDS

- The 2010 California state standards for Mathematics, English Language Arts, and Literacy in Social Science and Science should be completed.

- The A-G entrance requirements for admission into CSU and UC campuses should be aligned to the 21st century workplace (academia, government, industry, non-profits).

- California credentialing process should be adjusted to better reflect technology presence in classroom.

An additional benefit to the creation of a digitally enhanced learning environment would be the opportunity to increase the transparency of the educational process. However this would be dependent on many factors, key among them would be the dissemination of a consistent message to inspire and motivate all stakeholders to participate in a timely and deliberate way. If teachers see these changes as positively affecting them, making work more engaging - if they see them as really making a difference for their students and our future, and perceive that education leaders are backing them - motivation to go forward can occur. History shows us that the active cooperation of teachers and parents has been integral in successfully implementing changes in practice. Without their active engagement and buy-in, the process will falter.

Transforming California's 20th-century education system into a 21st-century learning environment is not just a matter of updating schools' computer equipment and keeping pace with changing technologies. It is a matter of sustainable economic development and global security. The task at hand is to align the human capital (students) with the experts (teachers) through state of the art tools (technology). This report is intended to serve as a road map to create and sustain incubators of learning and innovation, in order to enable California's educational system to successfully transition to the digital age.

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INTRODUCTION
Phase I Background

In 2010 a bipartisan group of California legislators asked the California Council on Science and Technology (CCST) to conduct an assessment of California's Science and Technology (S&T) Innovation Ecosystem. The first phase of this assessment, released in March 2011, focused on identifying potential legislative initiatives and transition plans of the new Governor, and presented findings from several regional leadership roundtables convened by CCST. Through these roundtable discussions, CCST identified three critical issues in California upon which to focus. One of these critical three issues was digitally enhanced education.

A fundamental premise for this i2i report on digitally enhanced education is an acceptance that the digital age has particularly far-reaching implications for education, and that California needs to implement a 21st century learning environment that reflects the ubiquitous presence of technology and fully utilizes the tools, competencies, and innovation that have become part and parcel of daily life. The digital age has affected students' learning, memory, attention and social relationships. Children and youth of this digital generation are defined by their technology and media use, their love of social connectivity through electronic communication, and their need to multitask. They enjoy access to unprecedented volumes of news and information around the clock. Their access to and use of digital technologies is not a fad, but a paradigm shift in how they access and use information.

Transforming California's 20th century education system into a 21st century learning environment is not just a question of following cultural trends, but rather a matter of ensuring sustainable economic development in California and enhancing our global security. The task at hand is to align the human capital (students) with the experts (teachers) through state of the art tools (technology).

Phase I recommendations included:

1. Identify a new kind of digitally enhanced education process and associated products that will be incorporated as a fundamental component of the state education system.

2. Catalyze the creation of new public-private partnerships able and willing to go to the next stage of implementation.

Building incubators of learning and innovation requires stakeholder engagement, resources to create new infrastructure, new approaches, and new technology. In this report, we present a case for an effective learning environment with the following characteristics:

- Innovative methods of teaching and learning

- A broad mix of learning providers

- Co-existence between formal education and informal learning

- Transparent and strategic technologies employed

- Learning experiences that are social, contextual, and continuous

CCST recommends that the state establish a California Education Innovation Consortium to promote digitally enhanced K-16 education.

PHASE II
Creating a Digitally Enhanced Education System

COMMON DIRECTIONS

Considerable research and scholastic enterprise has been devoted to how students and young people in general are learning differently.

TEACHING THE iGENERATION

Students born in the 1990s and beyond have grown up with a range of digital technologies (iPhone, iPod, Wii, iTunes, etc.) and the highly individualized activities that these technologies make possible. Children and youth in this generation are defined by their technology and media use, their love of electronic communication, and their need to multi-task. Children as young as three not only use the technology, but also display a mindset that expects it as part of their environment.

NEW TOOLS FOR THE iGENERATION

It is critical to shift from "knowledge as facts" to "knowledge as product." In the modern world, knowledge is produced collaboratively. Innovation and creativity, as well as the ability to solve problems in collaborative teams, are what is valued today and need to be embedded into the learning experiences of our children. Students need to focus on production instead of consumption, community building, and the convergence of all media and modalities into a suite of capabilities that can be used for creation and problem-solving.

In the mindset of today's students, textbooks are static references, not part of a dynamic "curriculum"; however, the establishment has not

made this leap. To achieve a truly 21st century learning environment, all stakeholders must re-think, re-imagine and re-conceptualize education. We need to move:

- away from an "information (lecture) system of education" where students work alone and are taught by isolated content experts, motivated solely by grades, assessed by multiple-choice testing, and where rigor is defined by content mastery and
- towards teaching content that is "transformational-based learning" based on exploring, where teachers are coaches and students learn in teams, where assessment includes digital portfolios and exhibitions, and where rigor involves determining the right question/problem to be solved.

COMMON DIRECTION

California's 21st century learning environment must be grounded in digital learning. Schools need to be transformed into "incubators of learning and innovation." The skills and competencies gained in these learning environments would be directly applicable to the workplace.

There is no lack of ideas and best practices which, if deployed, could effect significant change. However one of the real challenges is to navigate the fine line between a consistent, systemic approach that reaches throughout the state's large educational system, and flexible local implementation capable of adapting to and accommodating the range of needs throughout the state.

A recent report, Digital Learning Now, described a model digital learning environment comprised of ten core elements:[1]

1. **Student Eligibility:** All students are digital learners.

2. **Student Access:** All students have access to high-quality digital content and on-line courses, making available not only the opportunities for learning but also the future economic mobility that learning represents.

3. **Personalized Learning:** All students can customize their education using digital content through an approved provider.

4. **Advancement:** Students progress based on demonstrated competency.

5. **Content:** Digital content, instructional materials and instructors are on-line and blended learning courses are high quality.

6. **Instruction:** Digital instruction and teachers are of high quality.

7. **Providers:** All students have access to multiple high-quality providers.

8. **Assessment and Accountability:** Student learning (competency and demonstrated performance) is the metric for evaluating the quality and content of instruction.

9. **Funding:** Funding creates incentives for performance, options and innovation.

10. **Delivery:** Infrastructure supports digital learning. "Learning environments extend far beyond the physical boundaries of classrooms and labs, and education must adapt to these new expectations of crowd sourcing and social networking."

In October 2010, CCST in partnership with California State University, East Bay and TechNet, convened a summit of education stakeholders titled "A Call to Action: Advancing California's STEM Innovation Ecosystem." The ideas generated at this meeting resulted in a recently released white paper which offers a "bold new paradigm for transforming education – a Virtual STEM University employing an open learning ecosystem – that offers partners in business and education a pivotal opportunity and means to collaborate in rethinking, reimagining and reengineering teaching, learning and educational delivery systems to address the needs of the region's employers, students, and communities." The white paper presents a depiction of an open learning system that shows a "cradle through career" continuum including a road map with critical transitions and benchmarks.

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[1] *Digital Learning Now!* Foundation for Excellence in Education, December 1, 2010

STEPS TO TRANSFORMATION

In order to achieve this aspirational 21st century learning environment, specific steps would need be taken. The process of creating these incubators rests on four foundational pillars:

- The Classroom Environment

- The Teacher

- The Institutional Infrastructure

- The Partnerships

THE CLASSROOM ENVIRONMENT

California must redefine the classroom as a mobile learning environment which can be accessed any time, any place, in which students are engaged and have an active voice in what happens. Islands of best practices based on this approach have emerged throughout the state; these need to be fostered and replicated.

CCST's California Teacher Advisory Council (Cal TAC), comprised of a group of 12 top K-16 science, math and engineering teachers, has identified a number of innovative classroom models developed along these lines, which share many of the following characteristics:[2]

- The use of technology is encouraged and leveraged, instead of prohibited, for each course and grade level.

- Students' personal technology is integrated into the learning experience – technology is embraced not feared.

- The teacher/student/school community is technologically linked for swift and open communication.

- Students work collaboratively in a project-based learning atmosphere, solving today's problems, using today's technology, setting the stage for future innovators; the school becomes the training ground for innovation.

- There are sufficient personal devices for every student, offering much more individualized learning.

- A "technology mentor" provides real-time, on-site professional support for teachers in this innovative/digitally designed learning environment.

The early adoption of mobile learning tools enables students to create a personal learning network that will serve them as life long learners well beyond formal classroom instruction. It catalyzes a dynamic, rather than static, learning environment; the use of digital tools can transform how learning happens in the classroom.

THE TEACHER

California must foster an innovative learning environment where teachers work alongside, instead of in front of, their students in a collaborative environment with more opportunities for students to work at their own pace. Cal TAC is a key example of the best and brightest teachers leading in this new learning environment model.

Part of the vision includes a changed role for teachers. In this vision, teachers, like other professionals in the 21st century workplace, are facilitators, modeling problem solving and involving students in a collaborative learning environment. With this approach, teachers are free to instruct students on an individual basis. The learning environment transforms from the teacher standing in front of the class to standing by the side of the student. The teacher's role in this environment is crucial, forming real-world problems and then guiding students through the

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[2] Digitally Enhanced Education in California, California Council on Science and Technology White Paper, February 14, 2011.

analytic process as they consider possible solutions. Developing 21st century teachers who embrace this vision is key -- it sets the tone, expectations, and model for what an educator's role is in the classroom. This paradigm shift has to start early in teacher preparation programs: innovative practices with technology need to be an integral part of teacher education.

The creation of collaborative teaching teams is another tool that could revolutionize teaching. Moving from isolated instruction to team teaching better aligns with today's global workplace environment. In order for students to excel in team settings, they need to be taught how to work in teams. By fostering collaboration which supports risk taking and critical thinking skills in students, school and district leadership can transform the teaching environment from one of isolated practice into one that inculcates a team approach. It is critical that policy makers and administrators understand that this approach is about creating an environment for success where teachers will experience and understand how to function and thrive in this "Socratic Environment," where the teacher is a guide and facilitator rather than a lecturer.

THE INSTITUTIONAL INFRASTRUCTURE

The Institutional Infrastructure: California must ensure that the infrastructure in these learning environments keeps pace with the digital world by ensuring that students and teachers have ready access to digital learning tools and policies that support their use. California State University is an example of a teacher preparation system that has been connecting digital learning infrastructure to teacher training and development.

In researching various best practices, a number of recurring elements in institutional infrastructure are evident. A proper digital infrastructure should include the following:

Access to technology

- Every school wired with high-speed broadband and WiFi.

- 1:1 student laptop ratio and the freedom to use as they see fit (promotes innate, constant creativity and engagement).

- Tele-presence/tele-conference capability to bring specialized content to all schools.

- Remote labs to conduct distance experiments and collaborative programs.

Optimize effectiveness of technology

- A digital "commons" for current best practices in digitally enhanced education,

- A digital innovator at each school site, a highly skilled professional educator to support all teachers in the new model of teaching and learning. This digital innovator brings the innovative practices to life at the school and creates professional learning in real time; this would significantly transform and enhance teacher professional development

Create new ways to teach and engage students

- Technology that engages and involves rather than used simply as presentation tools. For example, have students create new media products as part of their interactive learning process. Additionally, three tools for educators can be found (free) on Intel's website:[3]

  1. Visual ranking (identify and refine criteria for assigning a ranking to a list; then debate differences, reach consensus, and organize ideas).

2. Seeing reason (investigate relationships in complex systems and create maps that demonstrate understanding of cause and effect.)

3. Showing evidence (construct well-reasoned arguments supported by evidence, using a visual framework.)

Strong Leadership and Support

- School sites embody an overall understanding of what technology can do from all angles of administration and teaching. It is critical to bring strategic planning and thinking to school administration processes.

Teachers are prepared and up-to-date on use of digitally enhanced pedagogy

- Professional development is embedded into the practicing classroom and involves mentors, team-teaching, expert partners and the digital innovator at each school site. The focus should be shifted to a professional innovation community.

- Teachers have to practice what they teach, using digital tools for their own continuing education with the same skills and functionality as their students. Digital tools for educators are part of the toolkit provided to them by the teacher preparation system.

THE PARTNERSHIPS

California must encourage and enhance public-private partnerships since they are a critical component for the development and sustainability of the envisioned 21st century learning environment. TechNet, CSL-Net, the K-20 California Educational Technology Collaborative,

and the California Emerging Technology Fund are among the many organizations leading this charge for communities of innovative learning through digital learning. California taking a leadership position in defining these new partnerships could catalyze investment by the private sector and increase job-creation opportunities that will lead to leadership in global markets.

Public-private partnership models are as varied and numerous as the local school districts nationwide. California has a definitive competitive edge, given that it is home to many global industries, federal laboratories, and incubators of innovation and creativity in fields and competencies capable of catalyzing digitally enhanced education.

Many different types of public-private partnerships exist that provide opportunities for industry and others to collaborate. Effectively leveraging them could involve:

A facilitation system to connect all types of partnerships and schools, thereby creating communities of innovation.

- Partnerships between the large tech companies (e.g., HP, Cisco, Apple, Intel) and schools, creating a "site" to facilitate connections. This is an exceptional opportunity to facilitate a system of connections with all types of partnerships and schools, creating communities of innovation.

- Partnerships with companies in a region where schools are not high performers yet companies want to grow their presence and workforce.

- Partnerships between technology-oriented schools with graduate schools of education (Cogswell, Cal Poly, UCI, etc.).

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[3] http://www.intel.com/about/corporateresponsibility/education/k12/tools.htm

Promoting partnerships with social media (e.g., Facebook, Twitter) to use online tools in K-12 classrooms. Many institutions of higher education have embraced new online tools to enhance education and encourage participation both in and out of the classroom. For example:

- The University of Missouri requires all Journalism majors to own an iPhone or an iPod touch, and Griffith University has an entire course dedicated to Twitter for its journalism students.

- Purdue University, one of the first to institute an emergency text-messaging system and an early adopter of Apple's iTunes U, is using social media tools to enhance the learning experience. For example, Hotseat, a social networking-powered mobile web application, creates a collaborative classroom, allowing students to provide real-time feedback during class and enabling professors to adjust the course content to improve the learning experience. Students can post messages to Hotseat using their Facebook or Twitter accounts, sending text messages, or logging in to the Hotseat website. This tool allows real time, hands-on critical thinking and communication.

In creating this new digital learning community, a next logical step would be to disseminate new learning practices to elementary and secondary education classrooms. Students would be on a digital learning pathway from "cradle to career" and better prepared to learn in this higher education digital environment. It could also potentially broaden student participation by those who dread speaking up in a crowded classroom – hence empowering disenfranchised students.

24/7 Access to Almost Anything You Need to Learn – For Free

Launched in 2008, the Khan Academy is a not-for-profit organization with the goal of changing education for the better by providing a free world-class education to anyone anywhere. All of the site's resources are openly available to anyone -- student, teacher, home-schooler, principal, adult returning to the classroom after 20 years, or a curious individual. Students can hear lectures at home and spend their time at school doing "homework"—that is, working on problems. It allows them to advance at their own pace, gaining real mastery, and it lets teachers spend more time giving one-to-one instruction. It has allowed teachers to take a big step toward humanizing their instruction. In fall 2010, Khan Academy began a pilot program with the public schools in Los Altos, California to help teachers customize their instruction, created a dashboard of robust data for them to follow, linked to their students' online exercises. Students don't move on to more advanced concepts until they have mastered basic ones. Those who get "stuck" promptly receive help, often from peers who are already proficient in a subject. The overall effect has been to create a more collaborative classroom culture.

The Khan Academy's materials and resources are available completely free of charge.

BARRIERS TO SUCCESS

Although for decades strategies and actionable plans for education reform have been presented at local, state and national levels, sustainable implementation with measurable impacts has not been achieved. Some, but not all barriers are attributable to budgetary constraints. Some are driven by public policy, practice, or preference.

ACCESS

- Every child in the state of California should have access to broadband capability.

- Every student is permitted and encouraged to use personal digital tools in the classroom to complement their education.

EDUCATION CODE

- Some of the existing Education Code in California present significant barriers to implementing digitally enhanced education. These are also a conducive to digitally enhanced education efforts.

STANDARDS

- The 2010 California state standards for Mathematics, English Language Arts, and Literacy in Social Science and Science should be completed.

- The A-G entrance requirements for admission into CSU and UC campuses should be aligned to the 21st century workplace (academia, government, industry, non-profits).

- California's credentialing process should be adjusted to better reflect technology presence in classroom.

RECOMMENDED ACTIONS

Creating and sustaining a 21st century learning environment for California's students and teachers based upon the four pillars will require a strategic approach that focuses on eliminating the identified barriers to success. Some of these will require policy and/or legislative initiatives, while others can be implemented locally, provided that leaders receive suitable support and encouragement. Some logistical barriers can be addressed through public-private partnerships.

California Education Innovation Consortium – In order to address these barriers in a systematic way, CCST recommends that the state establish a California Education Innovation Consortium to promote digitally enhanced K-16 education. This Consortium would comprise stakeholders from K-16 education, business, government, NGOs, among other and be charged to address the following suite of actions. This suite reflects near term low-hanging fruit opportunities as well as longer term, organizationally transformational actions.

ACCESS

1. Every child in the state of California should have access to broadband capability. This initiative could be designed and implemented through an innovation partnership with leadership from the California Emerging Technology Fund, California's Broadband Council and industry, government, academia, and non-profit organizations. The California Education Innovation Consortium could serve as the convener and catalyst to bring the various stakeholders together to develop an implementation plan and agree to a timeline.

2. Every student should be permitted and encouraged to use personal digital tools in the classroom to complement his or her education.

EDUCATION CODE

1. The existing Education Code in California contains a number of provisions that are conducive to digitally enhanced education efforts, and these provisions should be implemented to the fullest extent possible in a timely and deliberate manner. Unfortunately, few of the programs that are helpful are currently funded and those that are funded have received significant budget reductions. The legislative infrastructure is nonetheless in place to catalyze the vision captured in these respective codes.

2. California's Department of Education in partnership with the California Education Innovation Consortium should identify near- and long-term actions and implementation plans in consultation with the Legislature to fully leverage existing provisions of the code. Some challenges they should address are which sections to:

   • implement in the near term,

   • revise or delete so as to not pose barriers to the envisioned 21st century digitally enhanced learning environment

STANDARDS

1. Full and immediate adoption of the 2010 California state standards for Mathematics, English Language Arts, and Literacy in Social Science and Science should be completed. These standards have not been fully implemented, as the state has a moratorium on the development of instructional materials until at least 2015, with full implementation not scheduled to take place until 2017. Instructional materials include the development of a framework for each subject that goes into great detail on what and how standards are to be taught, textbook adoption and assessment creation. Key steps include:

   • The Legislature should move forward with immediate adoption of AB250 (Brownley), which would lift this moratorium so these new standards, based on the national wide Common Core standards, could be fully implemented by 2014. These new standards are focused on college and career readiness. The common core movement also released nationwide science standards in July 2011.

   • The Legislature should convene another Standards Commission to review and adopt updated science standards.

2. The A-G entrance requirements for admission into CSU and UC campuses should be aligned to the 21st century workplace (academia, government, industry, non-profits).

   • The CSU and UC leadership teams should revisit and update these entrance requirements to reflect changes in how students learn and how schools operate.

   • The Department of Education in collaboration with CSU and UC leadership should incorporate P21 skills to create a more wholly educated student body. These skills were developed by companies and are meant to guide schools and government on what skills are important in a globally competitive work environment. These skills should become part of the state standards and/or A-G entrance requirements.

In all three categories, opportunities are present for immediate action today through the engagement of key stakeholders and champions in implementing existing resources and policies.

Next Steps

Transforming California's 20th century education system into a 21st century learning environment is not just a question of following cultural trends, but rather a matter of ensuring sustainable economic development in California and enhancing our global security. The task at hand is to align the human capital (students) with the experts (teachers) through state-of-the-art tools (technology).

• Work with State agencies, the Legislature and private sponsors to agree on terms of reference for am implementation plan and to secure a mandate from state to proceed.

• Seek funding from private and public sources.

• Establish a California Educational Innovation Consortium to promote digitally enhanced K-16 education.

Plans for Implementation

1. Develop a Framework for Digitally Enhanced Education in California. This can be used as a template for the detailed study with an emphasis on those areas where CCST can help inform the process and have the greatest impact by bringing science and technology innovation ideas and options into play.

2. Develop a Timeline for Implementation (12-18 months.

3. Prepare an Assessment of the Recommendations.

4. Prepare an Information Gap Analysis and Develop a Process to Close the Gaps: Clearly identify what information is known and where there are information gaps, definitional conflicts and other issues that need to be addressed.

5. Perform an Asset Analysis of the Tools and Capacities.

6. Integrate all of the above into a viable plan with clear and actionable recommendations with an emphasis on the development of a "digital commons" to share best practices in digitally enhanced education.

7. Prepare a case for actions that the State of California needs to take in order to make fact-based decisions on future digitally enhanced education options and issues. This recommendation to the Legislature and the Executive branch (including state agencies) will clearly identify where CCST can help. Many of these recommendations can leverage existing tools or with refinement/ relooking at interpretation of legislation to better align to 21st century learning environment.

APPENDIX A
California Policies and Education Codes that Impact Digitally Enhanced Education

BROADBAND ACCESS

Making broadband access ubiquitous has been on the radar screen for many years in California. It is a critical tool to ensure California's competitiveness in a global market place. Various private and public initiatives are underway. In March 2011, Google announced the competitive selection of Kansas City, Kansas as the first site of Google's ultra high-speed network. The agreement with the city and in collaboration with local organizations, businesses and universities will bring the next generation web experience to the community with free broadband Web access for schools and speeds 100 times faster than the current average. Google has specifically partnered with the Kauffman Foundation, KCNext and the University of Kansas Medical Center to help develop the gigabit applications of the future, which envisions service beginning in 2012.

California's Broadband Council is actively engaged in fostering access and has issued the following recommendations:

- Leverage educational opportunities to increase broadband use. Ensuring high-capacity broadband connections coupled with a robust technology support system, relevant curriculum, literacy standards, and off-campus educational partnerships will provide California's students with the skills they need to compete in a 21st century economy.

- Continue state-level and statewide leadership Continuing the California Broadband Initiative and supporting the creation of

Community Broadband Leadership Council will strengthen the statewide leadership necessary to drive broadband access and adoption across California.

As recently as March 2011, Dr. Chester Haskell offered a clarion call. The lack of bandwidth in the United States is a huge barrier to taking full advantage of technology's potential, Dr. Haskell said, especially compared with what is available in other countries. South Korea has been particularly ambitious, announcing (and well on its way to reaching) goals such as wiring every home and office in the country at blisteringly fast speeds of 1gigabit per second by the end of next year. (The current average in the United States is about 3-4 Mbps per second.) It is no coincidence that South Korea is already the world leader in massive multiplayer online games. A related barrier is accessing connectivity, once it is in place — both in terms of infrastructure and in terms of cost and affordability. "High-speed broadband," Dr. Haskell said, "should be an unnoticed utility."[4]

ACCESS RESTRICTIONS

There are many initiatives nationwide that are fostering communities of open access for learning and innovation. For example, Project K-Nect is designed to create a supplemental resource for secondary at-risk students to focus on increasing their math skills through a common and popular technology – mobile smartphones. Ninth graders in several public schools in the State of North Carolina received smartphones to access supplemental math content aligned with their teachers' lesson plans and course objectives. Students communicate

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[4] Dr. Chester Haskell, Cogswell *Imaging the Future: Digitally Enhanced Education in California*, Cal TAC Summit, March 25, 2011.

and collaborate with each other and access tutors outside of the school day to help them master math skills and knowledge. The smartphones and service are free of charge to the students and their schools due to a grant provided by Qualcomm, as part of its Wireless Reach™ initiative. Research on the program has shown a measurable effect on students' math achievement and their interest in the subject. Teachers say one of the biggest benefits they've seen from the use of the technology is that students' confidence levels and their ability to truly understand and explain the math they're doing have risen. For teachers, another plus is that the smartphone allows them to track students' actions with it; teachers can tell how long students spend on a particular problem, for example, and whether they're posting questions and answers or communicating with classmates via instant messaging. Although in the early stages, a 2010 program evaluation conducted in the Onslow, NC, district by the nonprofit Project Tomorrow shows that students in Project K-Nect classrooms were more likely to achieve proficiency on the North Carolina end-of-course exams in Algebra I and Algebra II than other students in their schools and across the district and state.

EDUCATION CODE

California Leaning Resources Network (CLRN) has experienced funding cuts due to reduction in state-provided funds, however success is possible since other funders could be encouraged to increase support and/or additional supporters could join. A no-cost approach to encouraging support for this network would be working with the Governor and the California Department of Education to offer a letter of support that CLRN leadership could use in a funding campaign to achieve full funding.

This is a really important network for spreading the use of electronic learning resources. It Is a natural

fit with the pilot project suggested later in this report.

California's Education Code currently has considerable authority that is conducive to digitally enhanced education efforts. Unfortunately few of the programs are currently funded and those that are have been significantly cut. [5] Several specific representative areas are identified for action under key categories noted above:

THE CLASSROOM ENVIRONMENT AND THE TEACHER

California Learning Resources Network (CLRN)

51872(b): "Funding shall be provided through the annual Budget Act to the Superintendent of Public Instruction to provide centralized statewide educational technology services [SETS] that address locally defined needs and are more efficiently and effectively provided on a statewide basis. The statewide educational technology services to be supported by this statute shall include, but are not limited to, all of the following:

1. Review of electronic learning resources including, but not limited to, software, online resources, and video, for alignment with the content standards adopted by the state board.

2. Professional development focused on digital school leadership for educational administrators in the areas of data-driven decision making, integrating technology into standards-based curriculum, technology planning, professional development needs of staff, financial planning for technology, and operations and maintenance…"

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[5] *Digitally Enhanced Education: Education Code Research and Findings,* Stacey Kyle, May 2011.

Multimedia Instructional Materials

60051(a): "The department shall, as a pilot program, authorize 12 schools to request publishers to make instructional materials available for purchase in an electronic multimedia format pursuant to subdivision (e). A school district shall apply on behalf of a school to participate in the pilot program. Before authorizing a school to participate in the pilot program, the department shall certify that the school district that is applying on behalf of the school has no unmet needs for instructional materials. A school district shall seek funding from the federal Enhancing Education Through Technology Program or through the No Child Left Behind Act of 2001 (20 U.S.C. Sec. 6301 et seq.) or other discretionary funds for purposes of the pilot program. Participating schools may also use moneys from the State Instructional Materials Fund, pursuant to Article 3 (commencing with Section 60240) of Chapter 2 of Part 33, for purchase of instructional materials for the pilot program…

(f) A school that participates in the pilot program shall ensure that each pupil is provided with the electronic equipment necessary to utilize instructional materials in an electronic format. If the electronic equipment requires repair or maintenance, the school shall ensure that a pupil is not denied access to a computer for more than two consecutive schooldays."

This innovative pilot project was never acted upon. It would seem likely that communities within the state could create the will and capacity to take advantage of this opportunity. In order for this to occur, local school and district leaders, willing and able teacher(s), and a supportive community would need to create partnerships and cultivate external funders.

Use of Cell Phones in the Classroom

48901.5(a): "The governing board of each school district, or its designee, may regulate the possession or use of any electronic signaling device that operates through the transmission or receipt of radio waves, including, but not limited to, paging and signaling equipment, by pupils of the school district while the pupils are on campus, while attending school-sponsored activities, or while under the supervision and control of school district employees.

The use of cell phones within the classroom is not technically against the education code. However, it has been implemented as such due to conservative interpretation of the code by local IT departments. It would be valuable for the California Department of Education to issue guidance to local IT departments on the use of cell phones for instructional purposes. The challenge then lies in having staff able to utilize and manage students using the technology productively in the instruction. Key steps to achieve this change would include securing the agreement of local district policymakers and providing professional development for teachers on how to incorporate cell phones into their instruction.

THE INSTITUTIONAL INFRASTRUCTURE

Instructional Materials: Advertising

60048(b): "The governing board of a school district may not adopt basic instructional materials, and other instructional materials required to be legally and socially compliant pursuant to Sections 60040 to 60047, inclusive, including illustrations, that contain a commercial brand name, product, or corporate or company logo unless the governing board make a specific finding pursuant to the criteria set forth in paragraph (5) of subdivision (c) of Section 60200 that the use of the commercial brand name, product, or corporate or company logo in the instructional materials is appropriate."

An example of the conflict represented by this code is the use of iTunesU materials in the classroom. Changing interpretation of this code would be easy if the California Department of Education issued guidance to local IT departments, as well as local policymakers, that the potential exposure of students to advertising through the resources available (at no cost) via iTunesU was outweighed by the instructional advantages of the resources themselves.

The K-12 High-Speed Network (K-12 HSN)

11800(a)(1): "…established for the purpose of enriching pupil educational experiences and improving pupil academic performance by providing high-speed, high-bandwidth Internet connectivity to the public school system…
(2)(b): The K-12 HSN shall provide critical services and functions for public primary and secondary local educational agencies, including, but not limited to, all of the following:

1. Reliable and cost-effective Internet service.

2. Reliable and secure interconnectivity among K-12 entities in California, connection to higher education institutions of California, and connection to state and local agencies to facilitate efficient interaction, including transmission of data.

3. Videoconferencing and related distance learning capabilities.

4. Statewide coordination of network uses to benefit teaching and learning…"

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