ARE WE INNOVATION-READY?
A bold new model for higher education

Office of the President
American higher education is at a major crossroads. While higher education continues to play a vital role in supporting the United States’ economy, recent and cumulative research shows that the current model of higher education—which includes both public and private institutions—is not financially sustainable. Our students are not confident that an increasingly expensive college education will enhance their chances of securing employment. And employers are not satisfied with the ability of the nation’s college graduates to adapt to change and advance in their careers. Unlike other industries, higher education has not fully integrated emerging technologies and tools to address these urgent problems. To ensure the vitality of the nation’s economy and the health of our democracy, higher education must make a radical shift in its approach to teaching and learning.

What are the challenges?

- **The U.S. needs to develop and expand a highly adaptable, innovation-ready workforce to sustain a vibrant economy**
- **Growing student loan debt and poor job placement leave many students questioning the return on investing in a college education**
- **Higher education institutions must reduce costs and better prepare graduates by embracing technology and emerging educational tools**

Today’s students are digital natives. Interacting with the world using the latest device is a way of life. Likewise, most industries stay viable and competitive by using ever-evolving ways of connecting and communicating. As *New York Times* columnist Tom Friedman recently observed: “Given the pace of change today, [new graduates] will have to reinvent, re-engineer and reimagine that job much more often than their parents if they want to advance in it.”

An April 2013 study by Hart Research Associates found that employers don’t feel confident that college graduates have the 21st-century skills—critical thinking, problem solving and oral and written communication, for example—that would allow them to adapt and advance beyond entry-level positions. How do we prepare our students to be successful, particularly as the tools needed for careers in all fields keep changing? Compounding this dilemma is the grave financial outlook for the higher education sector, including elite institutions with large endowments.

To reduce costs and equip all students with 21st-century skills, we must change multiple components of higher education in parallel. The purpose of this paper is to explore real, scalable and transformational solutions for the immediate and long-term future of higher education. The proposed framework for higher education builds upon the use of emerging tools and methods in teaching and learning, including massive open online courses (MOOCs), addressed in “The Open Learning Ecosystem: Transforming Education Through Virtual STEM University” and “Reinventing Public Higher Education: A Call to Action.”

Most importantly, it considers the urgent need to meet our
local, regional and national human capital needs, reduce costs and ensure students’ return on investment in their education.

The value of innovation-readiness

Many argue that a college degree is necessary to ensure gainful employment. But what is the value of investing in education if students pay increasingly higher tuition rates and only get a pile of debt and no advantage toward job placement—or advancement—in return?

During the first decade of this millennium, the price for a bachelor’s degree, including tuition, room and board, rose 42 percent in public universities. At the same time, more than half of recent graduates are either unemployed or underemployed. In fact, young people are three times more likely to be unemployed, compared to their parents.

More alarmingly, a recent McKinsey & Company report titled “Education to Employment” found that half of youths are not confident that a postsecondary education will enhance their chance of securing employment. The report stated: “employers, education providers and youths live in parallel universes.” Based on a survey and analysis across several nations, including the U.S., the report showed that while 72 percent of education institutions feel their graduates are adequately prepared, only half of youths and 39 percent of employers believe that graduates have the necessary skills. In the U.S., the numbers were 44 percent and 45 percent, respectively.

According to Hart Research Associates’ “It Takes More than a Major: Employer Priorities for College Learning and Student Success,” more than three in four employers say they want colleges to place more emphasis on helping students develop five key learning outcomes: critical thinking, complex problem-solving, written and oral communication and applied knowledge in real-world settings.

While addressing low achievement and career preparation has been a topic of concern for lawmakers and policy architects, most governors across the country have continually reduced funding to education, especially higher education. And a recent Moody’s report calls into question the financial viability of all public, private and elite universities and colleges: “The U.S. higher education sector has hit a critical juncture in the evolution of its business model. Most universities will have to lower their cost structures to achieve long-term financial sustainability and to fund future initiatives.”

—Moody’s Investors Service

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7 McKinsey & Company, “Education to Employment,” http://mckinseyonsociety.com/education-to-employment/report. While 39 percent of educational institutions believe students drop out due the difficulty of courses, only nine percent of the youths believe this is the case. Similarly, 58 percent of youths indicate that hands-on learning is an effective method, as opposed to traditional training. Finally, almost a third of high school graduates decide not to enter postsecondary education because of cost.
8 See footnote 1.
To bolster the U.S. economy, President Barack Obama has called for a substantial increase in college graduates by the year 2020, particularly in the STEM disciplines, where there is growing global competition in information and technology sectors. To meet President Obama’s goal of raising college degree attainment from 30 percent to 60 percent, higher education institutions need to double the number of students who graduate—though paradoxically, universities are asked to do this with severely reduced funding.¹⁰

**Disrupting the status quo**

The time has come for urgent action if higher education is to establish a flexible and stable model that will enable universities and colleges to prepare graduates with the 21st-century skills employers seek—and thereby support the nation’s economy.

At a number of points in U.S. history, there have been bold approaches to education reform. We can extract successful strategies from these examples and leverage modern online educational delivery methods to cut costs, expand access to more students and ensure that graduates in all fields are innovation-ready.

In July 1862, President Abraham Lincoln signed landmark legislation: the Morrill Act. The act opened the possibility of higher education to the working class—and was an audacious measure to democratize higher education. It expanded the tradition of classical education and included engineering, agriculture and military sciences.

This momentous resolution changed the trajectory of our nation to unprecedented economic vibrancy and tremendous technological advances.

Examining the World War II pilot training program can also provide insights on how both access to and graduation rates from education programs can be significantly expanded. From 1937 to 1945, the U.S. Air Force ramped up production of pilots graduating from advanced training. As war approached, the goals kept increasing—from 187 pilots in 1937 to 250,000 pilots cumulatively by 1945.¹¹

Affordable healthcare is creating a similar emergent need for more skilled workers between now and the end of 2014. Currently, there are roughly 84 million uninsured individuals in the U.S., including approximately 7.1 million in California.¹² There will be a penalty for not signing up for health insurance, indicating a massive need to educate individuals in healthcare and related fields. Given the compressed timeline, our current traditional educational delivery methods will fall short for this and other challenges ahead.

Massive educational reform is not unprecedented. However, a major challenge is that technological innovation has not impacted the core of higher education, as it has in other industries. Many higher education institutions have been pulled into the quagmire of institutional rankings,¹³ such as the popular *U.S. News and World Report* rankings of colleges and universities. Enhancing institutional prestige often quashes innovation and a drive toward increas-

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¹¹ In the early years, recruitment took place in colleges. Students were recruited and put on reserve, while supplying them with some flight lessons. Before the war, two years of college was required to enter the military pilot training program, but that requirement was dropped after the war began. Standards for pilot trainees were liberalized somewhat and an examination was substituted for the required two years of college. Once enlisted, instruction began and much testing was given, including psychological testing. Instruction was broken into phases: primary, basic, advanced and pre-flight. In order to increase the production of pilots, the lengths of the first three phases were shortened. The other major change was that many instructional centers were opened and instructors hired. In 1939, nine high-quality civilian schools were contracted to do training at the primary flight level. In 1943, the number was increased to 56. In 1939, the length of the training period was reduced from 12 to nine in 1942, but still included 60 hours of flying time. The main problem was getting competent instructors. Those who finished this schooling were considered to be pilots and entered the Operational Training Units (OTUs), from which cadres were selected at random to train in instruction and leadership. They were given six weeks of training. The cadres taught at the instructional level and served as leaders in the OTU units, which were broken up into parent groups with satellite groups that represented different specialties. For others, continuing training and preparation for combat.

In evaluations such as the U.S. News and World Report rankings of colleges and universities, the institutional ranking is heavily weighted based on the level of the university’s endowment, the amount spent per student and selectivity based on the percentage of applicants accepted. In other words, the institution that spends more per student, is very well endowed, has higher tuition and admits the smallest percentage of its applicants is ranked high. Unfortunately, none of these rankings takes into account whether the institution is being innovative or is fostering entrepreneurship. Imagine if this were applied to any other industry, where the highest ranked company spends more for every unit of its output, has the most expensive product and has the highest asset base.

According to Anthony Carnevale and Jeff Strohl, “Prestige is an intangible and insatiable target for postsecondary investments,” and a false proxy for quality of student learning. See “How Increasing College Access is Increasing Inequality, and What to Do About it,” in Rewarding Strivers: Helping Low-Income Students Succeed in College, ed. Richard D. Kahlenberg (New York: The Century Foundation Press, 2010), 71-190. 95.

Faculty expertise will be required if higher education is to create ever-evolving learning environments that engage a broad range of students. Currently, there is an emphasis on faculty research as a marker for success. The university of the Internet age will prioritize new areas of faculty work: collaboration, interdisciplinary endeavors and, above all, teaching in student-centered environments.

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15 In Jose Antonio Bowen’s Teaching Naked: How Moving Technology Out of Your College Classroom Will Improve Student Learning (Jossey-Bass, 2012), the author outlines how faculty members benefit from learning to use “technology that prioritizes the benefits of the human dimension” via various kinds of flipped classrooms.
Forging the future of unbounded education

To achieve reform on a massive scale, higher education must reimagine the very structure of the curricula that lead to a college degree. In the way that people get news and information from multiple sources—from other people, television, radio, social media, etc.—higher education must be open to the limitless permutations of blended learning that include face-to-face learning, tech-enhanced learning tools like MOOCs, and internships, service-learning and undergraduate research that are directly connected to students’ coursework.

Rather than debating the merits of face-to-face classroom experiences versus learning with online educational tools like MOOCs, higher education must focus on students by using high-impact best practices in teaching and learning. We’re learning that online educational tools and high-impact practices such as internships, service-learning and research experiences are not mutually exclusive. In fact, they work best when they are integrated. To ensure that students are innovation-ready upon graduation, universities of the future must integrate theoretical and practical knowledge, classroom and real-world learning, and campus and workplace experiences.

By using emerging technologies in innovative ways and by partnering with local, regional and global organizations, universities can reduce costs and support our nation’s economic vitality by increasing the number of graduates with 21st-century skills. The proposed framework for higher education that will accomplish these goals is guided by the following:

1. The infusion of 21st-century skill development throughout higher education.
2. An expansion of problem-based learning into higher education to encourage the interdisciplinary and highly engaged learning that advances these skills.
3. Through collaborations between universities and the community, the development of internships and other applied learning experiences that are an essential component of undergraduate education.
4. The widespread adoption of communication technologies to facilitate the integration of classroom and workplace, to track and assess learning outcomes across the two venues, and to enable students to record, reflect on and share their learning experiences and outcomes.


19 A critical skill that is gaining more importance, competency in computational sciences will help graduates with the ability to apply mathematical concepts to emerging challenges (i.e. financial, biological, environmental and other management sciences). New career opportunities in big data and predictive analysis make computational skills essential for all college graduates, regardless of the field of study.

20 See footnote 1.

21 Problem-based learning invites students and educators to traverse the boundaries of academic knowledge and real-world experience. A number of campuses have developed internship programs that formalize such boundary crossing in their students’ curricular and co-curricular experiences. Examples: Apple, Google and Genentech. At Google, “engineering interns are key players in daily innovation and have the opportunity to make big contributions” (Google.com). Another example: “Genentech’s internship and co-op programs are among the industry’s best, offering undergraduate and graduate students the chance to receive rigorous and meaningful work experience in one of the leading companies in biotechnology. As an intern or co-op, [students] will contribute daily to important projects and work.
21st-century skills

In a San Jose Mercury News editorial titled “John Chambers: A memo to 2013 college graduates—never stop learning,” the Cisco chairman and CEO wrote to this year’s graduates: “You will also be challenged to adapt to a changing workplace—a dynamic and ever-evolving environment where the ability to think critically and move quickly is paramount.”

As explained in “Reinventing Public Higher Education: A Call to Action,” higher education needs to focus on helping our students learn to adapt and to develop 21st-century skills, including adaptability, leadership, mastery of oral, written and visual communication across media, critical thinking, computational skills and quantitative reasoning, and mastery of core subjects such as English, economics, science, history and government.

We cannot simply prepare graduates for entry-level positions. Employers agree that both field-specific knowledge and a broad range of skills are necessary for advancement and long-term career success. To become innovation-ready, our students need to develop competence in their disciplines, technical know-how and the skills that will allow them to adapt to the evolving demands of their careers.

Problem-based learning

Some of the most promising innovations in teaching and learning today cross the artificial barriers between classroom and real-world learning. “Problem-based learning” has been successful at engaging secondary and post-secondary students, who apply their learning to compelling challenges that are relevant to their lives. Problem-based learning begins with a big idea or broad concept that can generate an essential question that reflects both students’ interests and the needs of their communities. Students then work toward a specific answer or solution that can result in concrete action.

Working collaboratively with the help of guiding questions, activities and resources, students explore the problem from multiple angles and generate multimedia projects (such as blogs, video presentations and public service announcements) that offer opportunities for both assessment and intellectual growth. Students who participate in problem-based learning have been shown to exceed typical learning goals and demonstrate a range of skills identified as critical to the 21st-century workplace.

When developed with careful curricular scaffolding and in active collaboration with community partners, applied learning experiences have been shown to be powerful high-impact practices that heighten student success while strengthening the role of the university in workforce development.

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22 Students could work in multidisciplinary teams, with each member concentrating on a different aspect of the problem being considered. For example, a team might work on examining the relationship between diet and health from a social science perspective. Some students would have completed or would be using MOOCs or other experiences to learn about the impacts of such factors as poverty, migration, culture, religion, history and gender on food preferences and eating behaviors, seeking to understand the role of social context in diet. After examining the issue from the various social science perspectives, this group might form a new group or combine with a group of students studying science, who might bring perspectives from biochemistry, physiology and genetics. Another example: Students could work to understand government processes. They might be assigned to address a current or historical social issue, such as response to a natural disaster. The event could be studied from historical and geographical points of view, spreading outward to the impact on supplies and services, care of the injured, impact on psychological health and on families and social institutions. Members of the group could then study disaster preparedness, rebuilding communities and economic recovery. Their ultimate focus would be on drafting laws and regulations to improve public safety and response to potential future disasters. In particular, they could study the processes through which such laws and regulations work their way toward adoption at all levels of government.


24 University of Cincinnati, for example, requires students to complete internships within the context of Learning Modules that “encourage the student to look at their internship holistically and provide the students with guided professional development” in line with learning objectives that are determined in close collaboration with their supervisors. One such objective is the goal that “students will be able to complete projects/tasks that will build on the skills learned in the classroom.”
University-community partnerships

To prepare students for an ever-changing workplace and to enhance students’ learning experiences, the traditional campus community must be expanded through partnerships with local, regional and global organizations—including public, private, for-profit and nonprofit organizations. According to a Hart Research Associates study, employers express the greatest confidence in the following practices to help students succeed beyond graduation: developing research questions and conducting research, completing a project that demonstrates acquired knowledge and completing an internship or community-based field project.25

A number of organizations have developed internship programs that benefit both students and the organizations that host and supervise them. For example, Christi M. Pedra, senior vice president for strategic new business development and marketing at Siemens Healthcare, developed an internship program at Siemens Hearing Instruments that links internship experiences to the students’ areas of study. It offers student interns meaningful platforms and projects in which to develop and demonstrate their learning. Structured reflection and communication are essential, Pedra and others assert, to student interns’ successful integration of academic and workplace learning.26

Joining the compelling curricular potential of problem-based learning with the high-impact practice of internships and other applied learning experiences, we envision new learning partnerships between campuses and various types of public and private organizations that will allow students to develop knowledge and skills with direct relevance.27 In addition, students now have the opportunity, with technology, to integrate classroom and workplace learning, to engage in reflection and assessment, and to demonstrate their learning and experience through multimedia presentations that have potentially broader applicability.

25 See footnote 1.
27 This model, known as cooperative education, was pioneered early in the 20th century by University of Cincinnati, Northeastern University and Drexel University as a way to integrate classroom and workplace learning. A recent national opinion poll, conducted for Northeastern University by FTI Consulting, finds strong public support for this model: “One of the largest majorities in the survey was the public’s support for cooperative learning, a model in which students integrate semesters of academic study with semesters of full-time paid employment in their chosen fields. Nearly nine in 10 Americans (88 percent)—and 94 percent of young adults—say that cooperative education better prepares students for professional success.” “Americans Believe Higher Education Must Innovate,” Northeastern News (November 27, 2012): http://www.northeastern.edu/news/2012/11/innovation-summit. See also Cheryl Cates and Kettil Cedercreutz, Leveraging Cooperative Education to Guide Curricular Innovation, The Development of a Corporate Feedback System for Continuous Improvement (Cincinnati, Ohio: Center for Cooperative Education Research and Innovation, 2008).
**Technology for integrating classroom and workplace**

Campus and workplace learning can be integrated through the careful use of Personal Learning Environments (PLEs). Mobile technology could allow student interns to bring their coursework with them (via podcast capture, iTunes U and iTunes U Course Manager) in the form of lectures, readings and other materials. At the same time, a number of possibilities exist for offering PLEs through which students could engage in structured reflection and self-assessment, consult and collaborate with teammates both near and far and prepare electronic portfolios that demonstrate their achievements in ways that they can share with future employers, teachers and collaborators.28 “In addition to a resume and college transcript, a large majority of employers say an electronic portfolio demonstrating a student’s work and key skill and knowledge areas would be useful in evaluating potential candidates for hire.”29

By using emerging technologies and problem-based learning to integrate applied and classroom learning, we foresee the possibility of creating a new learning partnerships on behalf of the students, who are both the subjects of our common concern and the agents of our shared future.

> “We envision new learning partnerships between campuses and various types of public and private organizations that will allow students to develop knowledge and skills with direct relevance.”

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28 For example, the iWork Suite in Mac OS X Snow Leopard contains a wiki feature that allows seamless collaboration. Educators have successfully used its iWeb feature to create personal e-portfolios that students can bring with them from campus to workplace.

29 See footnote 1.
A bold new model

Our proposed theoretical framework can be applied to any university system. Our earlier white paper addressed the creation of new learning pathways for lower- and upper-division education for undergraduates. Our intent is to expand this model to integrate and align with high schools and the workplace.

The California State University System is used as a model due to its size and representative demographics, as well as the variety of career opportunities available throughout the state. California has 11 percent of four-year college students and 25 percent of community college students in the country. However, the significant reduction of state funding has limited access for many students across the nation. One of the acute examples of access reduction has been experienced in California. A *Los Angeles Times* article described how in fall 2012 nearly 70,000 California community college students had to attend two or more different schools to take their required classes. The article also noted that course sections had been reduced by 24 percent and more than 472,000 of the system’s 2.4 million students had been put on waiting lists for fall 2012 classes.

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31 In addition, our intent is to develop an appropriate portfolio where students could finish all of their remedial needs while still in high school, as well as some or all of their first-year college work, using the aforementioned pathways.
One of the CSU campuses, San José State University sends roughly 8,000 graduates into the workforce every year. The model we propose could increase that number significantly. This goal is based on a framework that both creates more seats on CSU campuses—without adding any physical space—and reduces the time students spend earning their degrees.\(^3\)

The benefits of this model are both social and economic: supporting both the public good and the private good. More students with quality degrees will result in an increase in the number of people with greater access to and preparation for jobs. This will then improve quality of life by increasing the number of people above the poverty line. Most importantly, the framework is designed to provide equal opportunity—and a more personalized education—for all students.

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\(^3\) The additional seats come from students doing remedial math and some of their lower-level courses before attending college, reducing repeat rates, and working on some of their credits through internships. The time to degree is decreased by less migration from major to major and flexible start and end dates for courses. Online and blended courses are used in various ways that enrich and complement learning. This also works well for lifelong learners.

\(^4\) A “Linked Learning” approach may also be used here. Linked Learning for high school students includes “strong academics, a demanding technical education and real-world experience to help student gain advantage in high school, postsecondary education and careers.” See: http://www.lbusd.k12.ca.us/Main_Offices/High_Schools/Linked_Learning/

See also: http://www.connectedcalifornia.org/direct/files/resources/LLand%20Direct%20In%20School%20Directors_Framework%20Draft%202013\#39;03.pdf


\(^2\) Start with testing for learning disabilities. NOTE: This is not intended to eliminate students, but rather to supply appropriate support. Many students have learning disabilities but don’t get tested until after they encounter difficulties that may lead to low grades. We must also consider soft skills, hard skills and non-cognitive skills. From radio program This American Life: “Paul Tough discusses how non-cognitive skills—qualities like tenacity, resilience and impulse control—are being viewed as increasingly vital in education.” Studies show how poverty-related stress can effect brain development and inhibit the development of non-cognitive skills.

\(^3\) There are excellent online planning tools available. See this article written by Elizabeth Phillips, provost at Arizona State University, on advising using data analytics and technology: http://www.changemag.org/Archives/Back%20Issues/2013/January-February%202013/improving-advising-full.html.

\(^4\) A blended learning approach combines face-to-face classroom methods with tech-enhanced activities.

\(^5\) In a flipped classroom, the instructor uses a recorded lecture in lieu of lecturing in class. Students view the video lecture before they come to class—like they would traditionally read an assignment in a textbook as homework. Students and their instructor then spend class time actively working and discussing—rather than students passively listening to a lecture.

\(^6\) Our experience at San José State has clearly demonstrated that we need to develop creative ways to use MOOCs. For instance, using MOOCs for blended learning and flipped classes has significantly increased the success rates of students in gateway classes. Similarly, using MOOCs with course mentors for students, coupled with continual
UC systems. This allows students to get a jumpstart on their college requirements. These can be run during regularly scheduled class time, with additional afternoon study sessions.\textsuperscript{35}

**Pre-College Summer Camp:** Day camps are given in the summer with equal opportunity for all students. Participants enroll in a lower-division general education (GE) course. In addition, courses that help with students’ transition to college, similar to summer bridge programs, are also offered.

**College Instruction**

Instruction is broken into four phases, similar to the traditional four years of college, but each phase could be shortened to less than a year.\textsuperscript{36} In Phases 1 and 2, students have many choices for courses, including MOOCs, blended and face-to-face flipped courses. Considering that credit may be given for previous learning and that courses may be offered more frequently, these phases could take less than two years to complete. Students who have personal setbacks will be able to get back on track more easily. At the completion of Phase 4, students earn a bachelor’s degree. At all phases, the curriculum is aligned with workforce needs.

**Phase 1:** Advisors supply individuals with personalized pathways, using online planning tools.\textsuperscript{37} After Phase 1, depending on their progress toward degree, students either stay in the program or are advised to choose another major. Personalized pathways are constructed, allowing students to sample the various levels of analysis offered by the social sciences, including the individual, dyadic, group, family, social, global, cultural, geopolitical and macroeconomic levels.

**Phase 2:** This phase requires much more advanced instruction through scaffolded MOOCs, blended\textsuperscript{38} and flipped courses.\textsuperscript{39} MOOCs at this advanced level are beginning to be developed, but this requires input from community organizations. Libraries of materials are online and are accessible to instructors. The faculty plays a central role in learning and assessing student learning outcomes. In addition, Teaching Assistants (TAs) are needed to make MOOCs more interactive and for drop-in centers. TAs will be selected from the post-graduates, who will get specific training. MOOC courses may be particularly useful for students who travel abroad.\textsuperscript{40}

**Phases 3 and 4:** These are more interactive and experiential phases with faculty members and internships.\textsuperscript{41} Faculty members employ up-to-date teaching techniques, including flipped courses, which are often multidisciplinary and problem-based. Problem-based courses are motivational—with the necessary reading, writing, math, critical thinking and computational skills embedded in the course, which provides context for knowledge.\textsuperscript{42}

**Post-Graduation:** After Phase 4, bachelor’s degree holders either enter the workforce or go to graduate school.\textsuperscript{43} Employers will likely offer orientation training after graduates are hired. Some graduates are selected for special training to be TAs, leaders or support staff for Phase 1 and 2. All graduates could come back for professional development as their careers evolve or for lifelong learning.

review of students’ performance at a granular level, significantly increases persistence and success.

\textsuperscript{41} There are dozens of examples of how students might rotate through internships with various agencies and organizations that are dedicated to or touch upon the problem being examined. In all cases, multidisciplinary perspectives would be emphasized, working outward from the individual to the broader historical and cultural context. Reading, writing and critical thinking skills would be continually reinforced through shared writing assignments. To help with motivation, industry, social and government agencies—both public and private—will supply upper-level personnel, who will provide examples of real-world applications and introduce students to real-world social, political and global issues. Internships will be a part of Phases 3 and 4, year-round.

\textsuperscript{42} Knowledge without context doesn’t promote analysis or decision-making. This represents a major shift in teaching. This framework also includes capstone experiences, such as case studies, that meet only a few times a semester, where students work in teams. There might be one from each of several disciplines working together to solve a problem.

\textsuperscript{43} Certificates and professional degrees can be awarded in place of or in addition to doctorates. This model can be applied to graduate education in the form of “master projects.” The next step in the development of this model will be to tie graduate study to the workplace.

\textsuperscript{44} For instance, almost a quarter of century ago during the September 1989 Education Summit with President George H.W. Bush, the U.S. governors established a number of goals: “By 2002, America will finish first among industrial nations on international science and mathematics achievement tests … As an intermediate goal, in four years, by the time this year’s high school freshmen graduate—1993—I want the nation to be among the top five in science and mathematics and by 2002, the nation will be number one … Four years from today, I want every college diploma to be stamped with science and mathematics competence.”

\textsuperscript{45} See footnote 1.

\textsuperscript{46} Models: Siemens, Google’s Junior Product Managers, Cisco Academy and Apple’s problem-based model. One motivation for the community to develop internships or otherwise interact with college students is increasing the talent pool. Care must be taken to align with institutional and program learning outcomes. Internships cannot be “add-ons,” but integrated into the curriculum. Additional resources will probably be needed for logistics and assessment, especially in making it work at scale. Companies and organizations might, for example, fund a professor and group of students to the workplace.
Conclusion

The U.S. has set goals for higher education in the past, but we have not achieved them. Right now, advances in technology are outstripping the ability of a growing number of employees to remain employable. Many of our graduates do not have the 21st-century skills necessary to enter the workforce and develop their careers. Unable to find employment and strapped with student loan debt, our students are questioning the value of a college degree. And the current business model of our higher education institutions will not sustain the changes that must occur throughout higher education to secure the country’s economic future.

The model that we propose here constructs a dynamic pathway between high school, college and career. We must make our students more adaptable by making higher education more adaptable. In the words of Cisco Chairman and CEO John Chambers: “All of us must be innovation-ready, and realize that career growth will go to those who continue to leverage the 21st Century Mind by adapting, discovering and learning new skills.”

There are no quick or easy fixes to the challenges we face. Undertaken deliberately and collaboratively, testing and adopting our proposed framework promises to transform the very mode of undergraduate education in ways that will increase student engagement, meet our human capital needs, reduce costs to universities and colleges, and ensure students’ return on investment in their education. However, making the most out of the model will require the following:

Assessment approaches: Employers endorse high-impact practices that involve students in “active, effortful work—practices that involve collaborative problem-solving, research, senior [or capstone] projects, community engagement and internships.” We must match the content of these activities and emerging educational tools like MOOCs with 21st-century learning outcomes. With such learning outcomes, we can better equip students in all disciplines for ever-evolving careers.

Changing the role of the faculty: The role of the faculty is certainly changing, but remains central to the learning process. Rather than spending time to prepare a traditional lecture, instructors can focus on developing in-class activities that develop critical thinking skills and deeper understanding of the material. Instructors may also use data and analytics to serve students better. With analytics immediately available with MOOCs, for example, instructors will be able to help students earlier in the course, rather than waiting until the midterm or final exam to evaluate students’ progress and learning. All of the proposed methods in our model are dynamic. Faculty members will need to constantly innovate the way they teach using the latest educational tools.

Development of industry and community partnerships: Global mobility is creating a new dimension of competition for many sectors, including higher education. Universities must develop deeper and more meaningful partnerships with key industries in order to preserve their place in the global marketplace. Likewise, industry leaders and community organizations must help develop internship models that ensure that educational outcomes are relevant to 21st-century workplaces. If any higher education institution merely continues to deliver content without contextualizing the content—and fostering innovation-readiness—it will become irrelevant.

44 For instance, almost a quarter of century ago during the September 1989 Education Summit with President George H.W. Bush, the U.S. governors established a number of goals: “By 2002, America will finish first among industrial nations on international science and mathematics achievement tests ... As an intermediate goal, in four years, by the time this year’s high school freshmen graduate—1993—I want the nation to be among the top five in science and mathematics and by 2002, the nation will be number one ... Four years from today, I want every college diploma to be stamped with science and mathematics competence.”

45 See footnote 1.

46 Models: Siemens, Google’s Junior Product Managers, Cisco Academy and Apple’s problem-based model. One motivation for the community to develop internships or otherwise interact with college students is increasing the talent pool. Care must be taken to align with institutional and program learning outcomes. Internships cannot be “add-ons,” but integrated into the curriculum. Additional resources will probably be needed for logistics and assessment, especially in making it work at scale. Companies and organizations might, for example, fund a professor and group of students to work with them.

47 Grassroots hands-on learning environments such as HackerDojo (http://www.hackerdojo.com/) and TechShop (http://www.techshop.ws/) can also offer fertile collaborative learning and innovation environments that complement and enrich high school and university curricula.
We advocate three key calls to action, to be implemented in parallel:

**Improve access to technology**

The full use of emerging educational tools such as MOOCs assumes that all students have access to the Internet or smart mobile devices. Steps should be taken so that every child has access to broadband capability, even in the remotest parts of the state and the nation. Key cities or counties should serve as conveners and catalysts in bringing stakeholders together to implement such projects. Also, every student in the K-12 system should be introduced to computational sciences, learn basic coding skills and encouraged to use personal digital tools in the classroom. These new capabilities should complement students’ education and prepare them to become savvy users of technology in general—and prepare them to effectively use current and future educational tools.

**Assess university policies**

In some universities, if a student entering college has taken more than a specified number of college-level courses prior to their admission, the applicant is treated as a transfer student. This may imply that the applicant might be subjected to more strict admissions criteria. This could dampen the motivation of high school students to maximize their opportunity and take many college-level courses, including MOOCs, while still in high school. Universities that have such policies should review and revise them.

**Fund opportunities for high school students**

Funding is needed to make sure that the MOOCs and other emerging educational tools are available for high school students are aligned to the 21st-century workplace needs. This effort offers yet another opportunity for strong partnership among academia, government, industry, nonprofits and foundations, etc. Unfortunately, programs that fund these approaches are virtually nonexistent today. Legislators at both the federal and state levels should identify near- and long-term actions and implementation plans to facilitate and motivate an ever-larger number of high school students to take advantage of these new opportunities.

Certain sections of the existing education codes, both at the federal and state levels, need to be updated to facilitate the ability of all students to take full advantage of college-level MOOCs and other emerging educational tools while still in high school. For instance, when students are in high school they are not eligible for federal Pell Grants or state financial aid. Given the initial success of college-level MOOCs, the U.S. Department of Education and state legislators could offer financial aid pilot programs that would reimburse the cost of college courses that high school students successfully complete, if students are otherwise eligible.

Corporations and foundations could offer scholarships for students, especially if students complete college courses in STEM or other highly needed fields. Having scholarships would ensure that students have the opportunity to develop skills that will prepare them to adapt to the changing demands of careers in all disciplines.

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