



REMARKS FOR SR 68 STRATEGIC PLAN FOR SCIENCE AND TECHNOLOGY JOINT
COMMISSION EDUCATION SUBCOMMITTEE BY
RICHARD A. DEMILLO
DISTINGUISHED PROFESSOR OF COMPUTING
PROFESSOR OF MANAGEMENT
DIRECTOR, CENTER FOR 21ST CENTURY UNIVERSITIES

Good afternoon.

My name is Richard DeMillo. I am Professor of Computing and Management at Georgia Tech, Director of Georgia Tech's Center for 21st Century Universities (C21U), and author of Abelard to Apple: The Fate of American Colleges and Universities.

C21U is a new organization at Georgia Tech that is focused on innovation in higher education. A brief description of C21U is attached.

From 2002-2009 I was the John P. Imlay Dean of Computing at Georgia Tech. I joined Georgia Tech from Hewlett-Packard where I held the position of Chief Technology Officer. I have also served in government, most recently as Director of the Computer Research Division at the National Science Foundation. My remarks are based on a career of observing change in STEM education at the College and University Level.

I was asked to comment on the nature of the STEM classroom in 10 years. I would like to focus my comments on 3 over-arching principles that I believe will drive how STEM classrooms develop in the nation's colleges and universities. I believe these principles will also influence learning environments for K-12 STEM education and in technical colleges as well.

1. The role of technology: It is not possible to pick winning technologies a decade or more out from today. Technology curves do not work that way, and the success of a given technology depends on processes and people. 21st century technology applied to a 16th century curriculum is not a recipe for success for example. I make the argument in my book that despite massive investments, the last classroom technology that was such an unqualified success that it became ubiquitous was the chalkboard in 1801. There are some principles that matter however.
 - a. Value will drive technology choices. Much of what we used to think of as value-laden in education has become commoditized by OpenCourseware, iTunesU, P2P learning and virtual learning communities enabled by social networks. These are accelerating trends. The value that remains in the classroom is locked in the student-mentor relationship, and the winning technologies will be those – like P2P learning and support for project based learning that unlock those relationships.
 - b. Costs are out of control and need to be contained: There is a tendency to use 20th century metaphors for how to rein in spiraling tuition costs. As I make clear in my book, I don't think that is the primary role of technology. What technology does provide however is a way to focus costs on value-laden parts of the classroom experience. So, for example, expensive investments in lecture capture and delivery or so-called learning management systems that are aimed at a factory-like model of education will not be repaid with either improved learning outcomes or reduced costs.

- c. Models for engagement are undergoing dramatic change: Unacceptable completion rates, a changing demographic for higher education, and a more diverse set of expected learning outcomes combine to spell the end for the “lecture-test-grade” model of engagement. More diverse on-ramps and off-ramps will mark STEM classrooms in the future. Some people have used “gameification” or “badging” as metaphors for the ways in which traditional grades might be replaced with a more achievement oriented system of assessment. These methods will only scale with new technological innovation in areas as diverse as digital identity management and video game design.
 - d. Openness will drive technological choices:. Technologies that create walls, utilize proprietary systems and whose access models exclude rather than include participants are not likely to be successful. Openness in both systems and institutions creates more agile classrooms, where the introduction of new technologies does not disrupt how teachers and students function. Openness implies being open to whatever technology choices learners and teachers bring to the classroom. The opposite of open is closed. Closed systems ultimately drive up costs and are the most brittle when change is rapid.
 - e. Higher Education cannot outsmart the marketplace: Purpose built technologies – from learning management systems, to mobile teaching kiosks – will always remain behind what the marketplace is capable of delivering, It is a consequence of openness that open systems more easily accommodate evolutionary change while proprietary systems do not. In technology we talk about “technology curves” that exponentially improve performance at a given price. A lesson for all of us is that you cannot outsmart technology curves.
2. The role of teams: I recently heard former USG Chancellor Erroll Davis in response to a question about integrated math curriculum in high school say “The world does not come at you one course at a time.” The same observation holds for STEM education. The classroom in ten years will be a venue for team interaction in which biologists, computer scientists, and mathematicians, for example, will collaborate with students on projects and discussions. These kinds of collaborations might lead to a solution to a real-world problem like how to monitor disease transmission in developing nations. This is the essence of the Threads curriculum here at Georgia Tech that revolutionized undergraduate education in computing nationwide and was publicized by Thomas Friedman in his book “The World is Flat.” More than that, I believe that models like the one that is being explored at California’s Harvey Mudd College in which the Liberal Arts is integrated into STEM classes presents a vision of how such curricula might work. At the launch of C21U last week, a distinguished panel of educators talked about the emergence of new models that will drive classrooms and curricula and one of the things they were very sure of was that disciplines and departments will become irrelevant. If that is true, then classrooms will be venues for team interaction not stages for teachers to talk to classes.
 3. Do not miss opportunities: The number of highly qualified STEM teachers that are needed in Georgia and the Nation is only daunting if it is considered in isolation from the other forces shaping higher education. Georgia Tech produces a few thousand engineers and computer scientists every year. They are among the best in the country. Every one of those Georgia Tech graduates should be able to step into a classroom. Not many of them do today for many reasons: unavailability of education courses, licensing and bureaucracy, unacceptable pay and working conditions. We cannot solve all of these problems by imagining a futuristic classroom, but we can imagine how a changing STEM classroom in universities would remove at least some of those barriers. Integrating education into the Georgia Tech curriculum, for example would mean that every one of our graduates would, in principle be able to teach in a Georgia school. That does not happen today, but this is an example of an opportunity that should not be missed.

I would like to conclude by returning to technology. My colleague Gregory Abowd who directed Georgia Tech's Classroom 2000 project once told me that the failure of classroom technology had to do with concentrating on innovation that made things easier for the teacher rather than focusing on how to help students handle and understand an increasing flow of information. The student clearly has to be at the center of all of these discussions.

Translating these principles into choices for both curriculum and classrooms will be a generation-long challenge, but it is the kind of innovation that is taking place all around the world. My hope is that Georgia will play a leadership role.

Thank you.

Center for 21st Century Universities at the Georgia Institute of Technology

The Georgia Institute of Technology's Center for 21st Century Universities (C21U) is a living laboratory for fundamental change in higher education. C21U focuses on the role of disruptive technologies like social networking and innovations like open courseware, serving as a living laboratory for testing new educational ideas. Like the "garages" of Silicon Valley, C21U is an environment in which new ideas can be prototyped, tested and deployed in greatly accelerated fashion.

Reporting to the Provost and campus-wide in scope, C21U is administratively housed in Georgia Tech's College of Computing, consistently ranked among the best programs in the country, is a leader in the creation of computing breakthroughs that drive social and scientific progress. With its graduate program ranked 10th nationally by *U.S. News and World Report*, the College's unconventional approach to education is defining the new face of computing by expanding the horizons of traditional computer science students through interdisciplinary collaboration and a focus on human centered solutions. The Center for 21st Century Universities and its associated programs will ultimately lead to innovation in higher education and industry.

About C21U and the Georgia Institute of Technology

The mission of C21U is to foster and accelerate the invention, validation, adoption, and deployment of disruptive ideas in higher education. Experimentation in the form that universities will take in the twenty-first century is difficult to validate and deploy on a scale that will influence the national agenda in higher education. One key problem is that experimentation is nearly impossible without a "living" laboratory. New modes of delivery need to be tested with real students, new curriculum approaches need to be validated in the marketplace, new platforms need applications and content to succeed, and analytical tools need broadly based data to be truly useful. A successful laboratory has to be sufficiently rich and challenging to attract the best researchers and innovators. In short: it has to be a place where real experimentation can take place.

C21U will use the output of the laboratory to drive innovative, diverse, and maybe competing visions of higher education in the twenty-first century. The center will provide a way to experiment with and innovate in all aspects of higher education that can be affected by technological disruption. Among the capabilities envisioned by this laboratory are the following:

- Small teams of developers so that faculty may have their ideas prototyped
- A network of technology companies who are committed to creating partnerships on global basis

- Facilitators who will push past bureaucracy to bring ideas into immediate classroom use
- Support for faculty participation in national and international initiatives
- Access to commercialization expertise and capital to help advance innovative ideas into new companies

In the age of iTunes, open-source software, and online, for-profit universities, there are new rules for higher education. Georgia Tech is uniquely positioned among other universities because the Institute has a deep-rooted history of innovation and invention. Founded in 1885, Georgia Tech's growth thus far has largely responded to the needs of a state transitioning from the agricultural to the industrial to the digital age. The Institute has sought to meet the needs of each era by expanding its research horizons, examining what to teach, and redefining how to teach. As Georgia Tech looks to the future, it recognizes that a great university should not merely respond to changes after the fact, but in reality must anticipate change and shape the future. Nationally and internationally, Georgia Tech's task is to influence the ways in which problems are identified and solved, and the ways that students are prepared to evaluate, analyze, and resolve those problems. Georgia Tech can meet its twin goals of anticipating and shaping change by combining its technological perspectives, its strengths in critical thinking and problem solving, and through its increasingly interdisciplinary approach to scholarship. Using these strengths, Georgia Tech seeks to create new fields of study, solve new kinds of problems, create new opportunities, and lead in a way that benefits not just its stakeholders, but also all of humanity.

Georgia Tech is one of the nation's premier research universities, ranking seventh among *U.S. News & World Report's* top public universities. Georgia Tech's more than 21,000 students are enrolled in its Colleges of Architecture, Computing, Engineering, Liberal Arts, Management, and Sciences. Tech is among the nation's top producers of women and African-American engineers, and the Institute's engineering program consistently ranks in the nation's top five. The Institute offers research opportunities to both undergraduate and graduate students and is home to more than 100 interdisciplinary units plus the Georgia Tech Research Institute. The Georgia Tech educational experience is distinctive because of the combination of high academic quality within a public, technologically oriented university. The university is a national and international leader in scientific and technological research and education.

Expected Outcomes of C21U

C21U's impact is translational. The Center does not do research in education. Rather, it will serve as a pipeline for new ideas that have been tested and are ready for adoption; C21U will drive change across Georgia Tech's six colleges and will focus on cost reduction, enhanced access, and outcome improvement. The Center will be a source of data and expertise for public and private institutions and will influence institutional design and reform on a national scale.

C21U Activities and Projects

The Center for 21st Century Universities' sample projects include:

- Social networks for expanding the reach and effectiveness of student-faculty interactions
- Open learning platforms
- Social networks and virtual learning communities
- Peer-to-Peer learning
- Massively open online courses (MOOCs) as alternative learning environments for certain disciplines
- Artificial intelligence, online social filtering, and search technology for augmenting human advising
- Predictability in the undergraduate curriculum: technology for helping students plan to graduate on time
- Trend analyses for cost/value tradeoffs in selecting a college or university
- A dashboard for tracking the health of the research pipeline at American universities
- Evaluating commercial CRM models for enhancing the online course experience
- Quality clusters and self-accreditation
- Case studies of disruptive market forces and transformational change in higher education
- Comparative studies of curriculum change in the United States and Asia
- Tailoring Open CourseWare Repositories for accredited programs
- The C21U Value Index for Higher Education
- FlashPoint.EDU, an innovation accelerator for higher education
- Innovative degree programs and international partnerships
- Badges and onramps for enhancing completion in 2-year and 4-year institutions

C21U offers a variety of ways for anyone interested in the future of higher education to be involved in change. The ongoing C21U programs for 2012 include the following:

- The Georgia Tech Massively Open Online Course (MOOC)
- The FACTS program for developing analytic models for higher education
- Catalyst Workshops aimed at rapid-identification of near-term strategies for change
- The GTFire/C21U Innovation awards to seed promising faculty research projects

- FlashPoint.EDU: The first cohort of entrepreneurs will be admitted May 2012
- Fire Side Chats and other student-led initiatives (sponsored by the Roosevelt Institute Campus Network)
- TechBurst Competition: A student competition to create sharable video content that can be directly incorporated into the Georgia Tech curriculum
- C21U 2012 Presidential Forum: Georgia Tech President Bud Peterson will host an annual event to bring influential leaders decision-makers to campus to discuss change in higher education.