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Pressure Points: Accelerating Change in Higher Education (US Perspective)

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This article looks at the relatively slow pace of innovation within higher education in the United States in recent years and discusses five trends that are likely to accelerate that pace,as well as the role technology will play both in shaping these trends and in formulating a response to them.

The Campus Technology conference (formerly known as the Syllabus conference) is one of the biggest and best known meetings devoted to examining the role of computing in education in general, and higher education in particular. This year's conference, held in Boston, attracted a record number of over 600 participants (primarily CIO's, IT managers, and faculty) from 16 countries, despite the fact that it was mostly North American in focus – as clear an indication as any that the growing importance of IT in education is being recognized.

Yet it must have been striking to those who attended conferences of this kind in the past, how little different the topics covered at this gathering were from those discussed five, six, or seven years ago. A handful of examples:

- One of the key addresses was devoted to "immersive learning"(including VR and simulation), describing a 3D environment developed at MIT nearly a decade ago and very much resembling the Active Worlds (http://www.activeworlds.com/), which already in the late 1990's launched an interesting initiative called Active Worlds Educational Universe (http://www.activeworlds.com/edu/awedu.asp) offering educators worldwide free access to its technology and challenging them to explore and describe its educational applications.
- Most, if not all, distance learning initiatives presented at the conference used asynchronous tools as their delivery platform.
- The vendors of content-development tools, especially those for recording and streaming lectures, were well represented among the exhibitors, but there was a conspicuous absence of advanced tools for real-time conferencing, such as Webex, Centra, or Elluminate Live - despite the fact that at least anecdotal evidence suggests their growing use by higher education institutions in the US.

- The Sakai Project (http://www.sakaiproject.org/) – a collaborative effort of several large American universities aimed at developing an open-source platform for online learning was presented in several sessions and in the Exhibit Hall; while certainly interesting and gaining well-deserved popularity, it is hardly innovative – so far it produced just another version of a Learning Management System, in terms of innovation arguably one or two steps behind similar systems on the commercial side, such as Blackboard.

It was as if time stood still in the last six or seven years. To be fair, a number of innovative uses of technology were presented, but most were no more than proof-of-concept projects, often launched single-handedly by a particularly motivated faculty, their sustainability and scalability being at best uncertain. Is it indeed the case, as Chris Dede quipped during his talk, that "changing education is more difficult than moving a cemetery, in spite of the fact that it requires a similar set of skills"? At least on the surface, adoption of technology by education has been remarkably slow, especially when compared to research, business, or even everyday life of an average American. Yes, we have our computer labs, and wireless networks, and LMSs, and projector-equipped classrooms, but these have been around for years. In fact, some of us had WiFi networks installed in our homes *before* our alma mater rolled one out.

Large and venerable universities appear to have particular difficulties in that respect. Part of it is certainly a function of their self-perception as old and prestigious enough to not have to pay close attention to every new fad sweeping education or society. Partly it is due to their sheer size and the size of their bureaucracies; some compared large universities to supertankers – turning them by even a few degrees is a major, time-consuming undertaking, and that is one of the reasons why much smaller institutions are also much more eager innovators. However, it would be a mistake to assume that higher education is not affected by changes in technology. It certainly is, although the affects are much more evolutionary than revolutionary in character. It is like watching the forest grow – the change is hardly noticeable when it happens, but it becomes massive and profound with the passage of time. Moreover, the pressures on education, brought about by technology, are increasing due to several important trends that are impossible to ignore. As a result, the fact that education hasn't changed much in the last seven years is not a good predictor of the seven years ahead, during which the changes that are taking place are very likely to become much more obvious. The rest of this article is devoted to discussing these trends.

Social Computing

Social computing, also known under the somewhat catchier moniker Internet 2.0, is a profound shift in focus from *connectivity*, toward *collectivity*. For a Marxist that would be a near-perfect example of a change in quantity (more and faster connections) bringing about a transformation in quality (the way these connections are being used). It is no longer about having access to vast quantities of information at one's fingertips; the world predicted by Ray Kurzweil, in which "every person in the Western world will be able to find an answer to a question that has an answer" has nearly arrived, and so now we're

moving away from being mere consumers of information, and stepping into the roles of contributors, participants, collaborators, authors.

Perhaps the best, or at least the most often quoted example of social computing is the blogosphere, the densely interconnected social network of blogs, i.e. online journals posted on the World Wide Web, frequently updated by their authors and often equipped with a comments section, where the readers can post their thoughts and responses, in effect becoming de-facto co-authors of the blog. The rise of the blogosphere is a phenomenon nobody predicted 10 years go, and its importance is still difficult to assess. The numbers alone are staggering: an estimated 75,000 new blogs are created every day; 35% of Internet users in the US (11 million) had blogs in 2005; most students entering MIT (and probably any other university) admit to having their own blogs.

This affects education on at least two levels. One: it places some responsibility on educators to teach students how to use blogs sensibly. Some students don't realize, or simply don't care, that their blog posts become permanent public record, extremely difficult to erase, and that what they wrote in 2006 may come back to haunt them in 2016. In the age of Google it is quite inconceivable that some students are surprised that their "private" musings, which they posted with only their friends and family in mind, were picked up by other blogs or blog aggregators[1] – yet this reaction is not infrequent. Well-publicized cases of people losing their jobs over posts and comments on blogs help somewhat in dispelling the misconception of privacy and anonymity on the Web, but apparently not enough – that's why some high schools have developed policies on blogging, and an increasing number of universities offer their students blogging tools, which allow limiting access to a specific group of people (e.g. students and instructors in a course), the university, or opening it up to the whole wide world; these blogs are deleted when the student graduates.

Second: blogs can be a versatile educational tool. Some schools use them in lieu of newsletters, "pushing" constantly updated information toward current or prospective students; some use them to "pull" information from students, e.g. in the form of reflection on their own learning. Some faculty started using blogs for posting information (syllabi, office hours, reading assignments, etc.) and ongoing commentary about the course they are teaching. And then there is this interesting, if somewhat unnerving twist in the social networking phenomenon: students can and do easily find out information about their professors ("Whatever you do, do not sit in the front row in her class!").

Computational Learning

One of possibly several positive side-effects of the bursting of the Internet bubble in early 2000's, was the overabundance of bandwidth. Telecommunication companies, which had spent vast amounts of money building fiberoptic networks in the expectation of reaping huge profits from all the traffic that the commercialized Internet was bound to generate, found themselves with many miles of dark fiber that nobody needed. Strapped for cash, the telcos started selling this fiber for mere cents on the dollar. That's why the University

[1] Sites that collect and publish posts from other blogs

of Michigan was able to afford to purchase several dedicated frequencies (lambdas) in the already deployed fiber of the Michigan Lambda Rail – an acquisition that would have been out of its financial reach only a few years ago. The 10-gigabit networking that these lambdas enable will open new frontiers in visualization, high-definition videoconferencing, and research. Although, given the insatiable appetite of researchers for storage, computing cycles, and bandwidth, it probably won't be long before these new capacities are exhausted.

The above example illustrates the degree to which computing has permeated research; we now live in an era of *computational* science. This is, to a large extent, due to the important paradigm shift in science: in the past, it was theory and experimentation that dominated science; today, in many disciplines, this is no longer sufficient or even possible (how does one run an experiment on climate change?), and so modern science had to add simulation and modeling to its arsenal of tools in order to move forward, and that's part of the reason why computing power has come to play such a vital role.

What does this mean for education? Are we entering the era of *computational learning*, whatever that means? It would not be a stretch to say that yes, we have already, and it isn't just a matter of ubiquity of computing on college campuses: WiFi networks, digital libraries, LMSs, digital coursepacks, etc. One could argue that this is only infrastructure and this by itself does not change learning; this is a very valid argument – what truly matters is what is being done with this infrastructure. However, there is no arguing that we live in a data intensive world, and that this infrastructure played an important role in overcoming one of the crippling scarcities of the past, the scarcity of information. The faculty are no longer the only, or even the most important gateways to knowledge for students; in fact, some students come to campus with more knowledge in certain areas – e.g. computing technology – that their faculty; this introduces an interesting dissonance into the traditional student-faculty relationship. One way of dealing with this dissonance is to pretend that nothing happened, that the faculty is still the "sage on the stage". A much smarter, albeit more difficult way is to create a form of partnership between the students and the professor, in which the latter recognizes that he has something to learn from the students; as mentioned in the previous paragraph, certain tools, such as blogs, can be of enormous help in extracting knowledge from students.

Then there is the issue of expectations. Students, who have grown surrounded by abundant information technology in their private lives and in previous educational experience, expect no less from the institutions of higher learning. They expect to access library catalogs and building directories from their "smart phones"; to download their class assignments directly from entries in their schedules; to go on the Web to check whether any of the washing machines in their dorm are currently available. Some of it is clearly a matter of convenience, but even if it merely allows students to save time that they could (potentially) devote to learning, that's a net gain.

Most important, however, is the opportunity of connecting students to research. Powerful visualizations and simulations, made possible by high-performance computing, promote understanding and interest in science. High-speed networks and the scientific

collaboratories they enable allow students to not only observe science as it is being done, ask questions of the researchers doing it, but also to run their own experiments, remotely and safely controlling sophisticated scientific equipment, like deep-sea probes or high-altitude telescopes. Leaning can hardly get more “immersive” than this.

Distributed Learning

Closely related to computational learning is the notion of *distributed learning*. The relationship between these two is of dependence: the latter would be impossible without the former, and causality: the latter is what the former naturally leads to. It is a wide-reaching phenomenon, that is not yet well understood, and whose impact on education is likely to be profound. The first word of the term encompasses distribution in the geographical sense, reflected in what is called *distance learning*, but is not limited to it; it tries to capture in two words the complicated reality of education no longer built around the central polarity students-professors, but becoming multidirectional and multifaceted, and on an unprecedented scale.

It has been known for a long time, that learners have different “learning styles”, and so teachers were trained – with varying degrees of success - to use a variety of teaching methods appropriate to these styles, in order to engage the greatest number of learners. The ubiquity and power of computing is making this task easier than ever; students who would learn very little listening to a long lecture accompanied by the squeal of chalk on the blackboard now have access to games and simulations that impart knowledge in a form more palatable to these students. It is not, as some critics charge, a matter of making education “entertaining” and attempting (futilely) to remove any effort from it; at least not solely. In many cases it is a genuine and successful effort to reach students at risk of being left hopelessly behind. It is also the case that, as the changing society demands new skills from its workforce, new, more effective methods of teaching those skills are needed.

This distribution, or, more precisely, diversification of methods, is but one manifestation of this important trend. Spatial or geographic distribution is another. But while distance learning is still struggling to gain acceptance, the temporal distribution of education – its spread over time – is what’s driving the biggest changes on college campuses. First, there is the recognition that education has long ceased to be a time-constrained process, the great majority of it taking place between the ages of 6 and 24, and that it has become continuous and life-long, stretching well past a person’s retirement. How to deliver effective education to people, who would not consider moving into a dorm or abandoning their careers in order to pursue a degree, remains an open question, answer to which may well involve finding a really good way to teach at a distance.

Second, even the “stationary” students, already on campus, are pushing for on-demand delivery of education, accessible at any time of their choosing. The growing popularity of lecture podcasts, provides a good evidence of that. Of course, there is nothing new in the recording of lectures and making them available for replay – it has been done in the past with videocassettes, CD-ROMs, and streaming. However, these past methods required

obtaining the media with the recording, and/or having access to a replay device (VCR, CD player) that one rarely carried around, and/or having good connectivity. With podcasts, students can download a file to the ubiquitous iPod or a similar device, and then carry it around with them and replay it anywhere and at any time: while exercising in the gym, doing laundry, or driving a car to spend the weekend with parents.

Convenience is certainly an important factor in the popularity of podcasts among students, but there is some anecdotal evidence suggesting that there is more to it than that. For example, one would expect that student attendance at lectures would drop dramatically. (Why sit in a lecture hall listening to a talk that will be available a few hours later for download?) This hasn't happened, suggesting that students use these recordings as something other than replacements for live lectures. One usage reported by the students themselves was as a review material before an exam. Rather than take copious notes during the lecture (and lose some of it due to divided attention), students would simply listen to the recording. Another acknowledged use was to get a better understanding of the lecture. Sometimes listening to it more then once would uncover words or meanings missed the first time, leading to an "aha!" moment. This will become even truer when video podcasts replace the currently dominating audio podcasts, as students will not only hear the voice of the lecturer, but see the visuals presented as well.

Security

There was a time, when most Internet "mischief" was caused by young males out to prove their technological prowess and win bragging rights in the community of likeminded guys. During that time, higher education was rarely a target of attacks, in part because of its openness – there is little glory to be won by hacking into a network that's already quite open. Now, after "mischief" became highly profitable and attracted criminals, things have changed dramatically. In the world in which, according to FBI, a freshly stolen identity can be worth $2,000 on the "street", there are no "unworthy" targets – the massive theft of personal information of 137,000 people at Ohio University, discovered in May 2006, makes this painfully clear.

The recognition that computer and data security are important issues, which have to be taken seriously, has grown considerably among university CIO's. However, it is a difficult challenge that requires careful weighing of the need for security and privacy, against the seemingly opposite tradition of accessibility and openness. Security models developed for businesses unfortunately do not work very well for higher education. In part this is due to a business' heightened vulnerability to disaster: several days during which customers cannot make purchases may be enough to push a company into bankruptcy, while a university should be able to withstand longer periods of disruption without severely adverse effects. More importantly, however, a university cannot function well as a "closed system"; there is a point after which more security would interfere directly with the university's mission and hinder innovation. It is a difficult balance to strike, but one the CIOs will have to try to find, with the understanding that there will always be a degree of risk one will just have to learn to live with.

Accountability

University presidents and the public may be temporarily distracted by a borderline insane faculty member stirring up media frenzy by pronouncing that the people who perished in the collapse of the Twin Towers were "little Adolf Eichmanns"[2] or that 9/11 was a conspiracy of the US government[3], but sooner or later they will have to address questions such as: "How is all that money spent on IT helping the university achieve its mission? Is IT making a difference?". These questions are being asked more often and with greater urgency than ever before. This is due, in part, to the deep cuts in the financial assistance given to public universities by state governments, and to drying up of some of the corporate donations – both a consequence of the recession of the early 2000s; the shrinking pool of money is, predictably, being accompanied by bolder demands for accountability.

This is somewhat new and shocking to large American universities, which have been used to their position in the society not much different from that of principalities in medieval Europe. In addition, the very idea of placing IT expenditures, which only a few years ago were seen as unquestionable necessity, under scrutiny, must appear nearly blasphemous to some. It has always been taken for granted that in higher education investments in information technology rarely, if ever, result in savings, and certainly not in lower expenditures for information technology. The opposite is true: despite the gains in more computing power per dollar, as codified in the Moore's Law, the large footprint of IT costs in university budgets is not likely to get smaller. Any savings realized by higher productivity or commoditization are immediately gobbled up by requests for more bandwidth, bigger hard disks, more nodes in a computing cluster. At the same time, although American universities are not viewed the same way as profit-generating businesses, they are not absolved from fiscal responsibility, nor immune against demands to cut costs. The question, "Are the money well spent?", cannot be dodged forever.

Unfortunately, when it comes to education, the sincere answer to that question is, "We don't know." It may seem surprising, but with all the research being done within the walls of a university, there is still not enough data and no conclusive evidence that technology on campus is having a positive impact on education. It is difficult, and yes, expensive to look for that evidence, especially since it isn't quite clear where to find it. (Are we to compare students who learn with technology and those who learn without it, and measure what? – whether one group retained the knowledge acquired in a course longer than the other? Or was more successful in subsequent courses?) It certainly isn't impossible, but daunting enough that little progress has been made so far.

Also: technology is a tool – having more of it, or more powerful, doesn't automatically change things, apart from budget calculations. In order to take advantage of technology in education, other things must change, for example, economic models and the system of incentives for teachers. The latter is pretty obvious and have been talked and written about ad nauseam: bringing technology into the classroom more often than not means more work for the instructor, and yet this hasn't been recognized in the way faculty are

[2] Ward Churchill, then at the University of Colorado
[3] Kevin Barrett, University of Wisconsin

awarded with pay or tenure. (This is slowly changing.) The question of economic models is more complex and beyond the scope of this article, but let's consider just one example of creative thinking in this regard.

University of Florida developed a successful online program offering certificates and master's degrees in four areas of forensic science (http://www.forensicscience.ufl.edu/). The program attracted significant interest both in the United States and abroad, prompting UF to establish partnerships with universities in Scotland and Canada, under the umbrella of Global Forensic Education (http://www.globalforensic.org/). That interest, not surprisingly, wasn't limited to highly developed countries, which could absorb UF's levels of tuition – developing countries, such as Brazil, were also very interested in having this program available for their forensic science professionals. UF decided to follow the footsteps of a… well known fast-food giant, and adopt the franchise model of international expansion: a UF team would help a university develop a localized "clone" of the Forensic Science program (including translation of all the materials into local language – Portuguese in the case of Brazil), and charge tuition appropriate for that country, sharing its revenue with UF. (Such localized program is still hosted on UF servers.) Contrary to the fairly common perception that distance education initiatives are likely to lose rather than make money, this program is generating substantial revenue for UF. Plans to create a similar program in journalism are already underway.

Nevertheless, the fact remains that university CIO are often expected to do the seemingly impossible: innovate, while barely having sufficient funds to keep things going. The good news is, at least as far as education is concerned, we may already have sufficient cyberinfrastructure to support a lot of innovation, and the challenge is not to build more, but to use what we have wisely and fully. Not that this is a small challenge by any means.

"It is difficult to make predictions, especially about the future.", as the Danish physicist, Niels Bohr, wittingly remarked. Part of the reason why this is so true is that future is hardly a linear extrapolation of the present - and now more so then ever. Ten years ago, how many people could have predicted Google or the explosion of blogging? And yet we have to plan and try to prepare by making educated guessed anchored in what we know at the moment; although this does not prevent the unexpected, at least it forces us to adopt the attitude of expecting change, of flexibility – this in itself can be enormously helpful and tends to be in short supply at educational institutions. At times of rapid change, flexibility is the next best thing to having a highly accurate crystal ball.

Of course, envisioning the next two or three years is not necessarily an exercise in futility. There are discernible trends and pressures – like the ones described above – that are likely to exert their influence for some time; there are assumptions that are fairly safe to make, and although they may not be applicable over the long run, they will not be proven wrong overnight. One such assumption is that in the near future access to computing for the majority of the world's inhabitants will be through cell phones. Will this affect how we think about distributed learning? It should. At least at MIT there

already have been proof-of-concept experiments at delivering educational content through devices like the Sprint Vision, that are a cross between a phone and a PDA.

Audio and video podcasting may ultimately prove to be a fad, but the need for mobility will not recede any time soon. Students may switch from iPods to other "pods" or an entirely different device, but having discovered the convenience and value of lectures that can be carried in a pocket and listened to anywhere, they are likely to demand more of that, not less. Students will also expect variety of channels (on top of the traditional ones) through which knowledge is shared with them and among them: games, simulations, the Web, virtual reality, and others opened by yet-to-be-developed technology. Finally, they want to be co-creators of their educational experience, not merely passive consumers. Sooner rather than later, meeting these expectations will no longer be optional for the institutions of higher learning.

One thing that could help universities adapt to change – if they chose to take advantage of it – is their openness. Notwithstanding its murky ideological underpinnings[4], the enthusiastic embrace of everything "open" - Open Source, Open Courseware, Open Standards, etc. – by the American academia seems genuine and substantial, and also rooted in its subculture. The university CIOs in this country do not hide behind a veil of "proprietary information" or "company secrets", but will readily share with their peers the problems they faced and the solutions they found. This willingness to share is an asset whose value is difficult to overestimate. Combined with flexibility, it could offer tremendous help in successfully navigating the narrow passage between innovation and good business sense in higher education.

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[4] Is the resemblance between Open Source philosophy and the communist ideal of a society, in which everybody would "contribute what he can, while taking what he needs" superficial and meaningless, or is it precisely the reason why the decidedly left-leaning majority of academics in America found it attractive?