

Introduction

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NEW TECHNOLOGY PORTENDS dramatic changes in higher education on a number of fronts. Colleges and universities function today in a competitive environment where the playing field has shifted to allow technology-enabled delivery of educational content. Teaching methods are being recast to leverage new learning media and honor multiple learning styles. Meanwhile, leading thinkers from both within and outside academia are exploring radically different approaches to teaching and learning.

The Forum on the Internet and the University (the *Internet Forum*) convenes during the annual symposium of the Forum for the Future of Higher Education (The Forum), held each fall at the Aspen Institute. The Forum is a community of academic leaders and scholars from across the country who explore new thinking in higher education, particularly about issues related to institutional change, strategy, economics, and technology.

The *Internet Forum's* research culminates at the Aspen symposium, where scholars present their work for discussion and debate. Its goals are to create a scholarly platform from which

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participants can explore how the Internet and related technology can improve learning, and to assess the opportunities and risks created by rapid technological change.

Scholarship presented during the *2001 Internet Forum* is offered here to share more broadly the insights, discussions, and inquiry that it sparked.

Disruptive Technology

Clayton Christensen, professor of business administration at the Harvard Business School, and Sally Aaron and William Clark, associate researchers at the Harvard Business School, focus on the effects of *disruptive technology* that change competition in their field. Christensen's theory, developed in the corporate realm, offers key lessons for colleges and universities as well. It is based on the constant pursuit of excellence by both businesses and higher education institutions. As the quality of products increases, they often surpass the needs of their consumers, leaving a gap to be filled by a disruptive innovation (a product or service of lower quality or performance that more closely matches consumers' needs). Other features make the innovation appealing as well, such as being cheaper, simpler, and more convenient to use. Early adopters of the disruptive technology or service most often are the least demanding customers in a market.

Christensen believes that in the relentless pursuit of quality, the nation's top business schools have overshot their market.

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Top Masters of Business Administration (MBA) programs can cost more than \$220,000, including opportunity costs, leading firms to stop sending their best employees to business school for two years, or to shorter but still expensive Executive MBA programs. Further, the average starting salary for MBA recipients graduating today from leading business schools is well beyond the salary structure of mainstream companies. These schools now serve a very small, high-end segment of the market for managers. Corporations have responded with their own disruption: The number of formally organized corporate universities rose from 400 in 1990 to a reported 2,000 in 2002. Approximately eight times as many people now receive management training in a corporate context than in MBA programs.

Similar disruptions are occurring at the community college level, which presents a low-cost model for higher education. Many students' needs are overshot by traditional four-year institutions; community colleges offer a less expensive and more convenient alternative for fulfilling educational needs. Over the past 40 years, for example, the Associate Degree for Nursing (ADN) has emerged as a low-cost, accessible, and recognized alternative to the Bachelors of Science in Nursing (BSN). The number of ADN programs in the United States has skyrocketed from 7 in the late 1950s to more than 850 in the mid-1990s. Today, more than 60 percent of all registered nurses are educated in ADN programs. This example provides valuable insight as to how other degree programs might be disrupted in the future.

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Advances in technology and increases in the demand for higher education at all levels facilitate focused, low-cost, and profitable private-sector entry. Christensen's research shows that disruptive innovations typically expand the market dramatically at its lower and mainstream tiers, and then migrate inexorably up-market, where, in the case of higher education, they will begin to challenge traditional degree programs. Christensen, Aaron, and Clark believe that disruptive innovation is not necessarily a bad thing and argue that successful disruptive business models could lead to higher quality instruction at lower prices for greater numbers of people.

Rethinking Teaching and Learning

The Internet and new learning media present myriad possibilities for improving teaching and learning. They range from simple and inexpensive online lectures designed to expand their reach to building costly multimedia, hands-on, interactive modules and manipulatives that students work on with teacher support. Just where ideal learning conditions lie on this spectrum depends on the subject matter and the learners' characteristics. Practical concerns, too, such as costs and technological capabilities, cannot be overlooked. Several Internet Forum scholars offer their vision as to how technology might best be applied to improve learning to meet the demands of the knowledge economy and a growing and diverse population.

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The Creative Society

Mitchel Resnick, associate professor in the Epistemology and Learning Group at the MIT Media Lab, describes how higher education can enhance its primary role in the spread of knowledge by using technology to reframe teaching and learning at all levels. Inspired by the physical objects and activities prevalent in kindergartens (but that give way to abstract formal methods throughout the educational process), Resnick describes his new approach as *lifelong kindergarten*. A growing body of research shows that people form stronger bonds with knowledge gained through concrete representations and physical activities that differ greatly from the abstract approaches favored in traditional curricula.

Resnick focuses on the use of *digital manipulatives*, objects that expand the range of concepts that children and adults can explore through direct physical manipulation. Small computers embedded in digital manipulatives enable the objects to take measurements, emit light, interact with each other, download programs to control their actions, and so forth. Perhaps the best known of these manipulatives created by Resnick and his colleagues are the programmable LEGOs found in many elementary school classrooms. In addition to the traditional LEGO building bricks, newer pieces such as gears, motors, and sensors can be added and programmed so that children can build, for example, a house with lights that turn on and off at particular times, or with garage doors that open when a car

approaches. Other objects include BitBalls, used at the university level to give students concrete experience with kinematic principles.

Resnick emphasizes the need to foster *digital fluency*, which moves the typical computer user far beyond word processing, e-mail, and Web searches. Using the analogy of learning a foreign language, he notes the difference between getting by on the “phrase-book” level in a foreign country and being able to articulate complex ideas or to tell stories—in short, being able to create in another language. Similarly, digital fluency involves not only knowing how to use technological tools, but also how to build new things with them. Resnick believes that while the access gap to technology may indeed shrink in the coming years, the fluency gap may widen unless measures are taken to directly address it.

Resnick’s hope is to build a new type of society based on a new approach to education. He describes the transition from an “information society” to a “knowledge society” as we realize that the key to change and progress is not information, *per se*, but rather how people transform information into knowledge. He moves up this trajectory to the “creative society” with a shift from how much we know to an emphasis on our ability to think and act creatively. If we summon the creative energy to take advantage of the possibilities presented by digital technology, Resnick believes, we can build the tools that will help us reinvent teaching and learning and, likewise, our future.

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Social Learning

John Seely Brown, chief scientist of Xerox Corporation and former director of the Xerox Palo Alto Research Center (PARC), reflects upon the nature of information and knowledge and the social context of learning. He suggests that perhaps the key distinction between information and knowledge is that information is usually considered independent of any particular individual (it can be looked up in a book or retrieved online), whereas knowledge is associated with a knower. Knowledge entails understanding information rather than merely holding it. Thus, the resources for learning lie not simply in information, but in the practice that allows people to make sense of it and in the practitioners who know how to use it. Learning is a remarkably social process.

Among the many important shifts in learning exhibited by today's technologically savvy students is their bias toward discovery-based learning and action. This tendency signals a shift from learning by receiving information to learning *in situ* with and from each other. Learning becomes as much social as cognitive, concrete rather than abstract, and intertwines with exploration and judgment. Brown likens knowledge to a tree: The leaves, branches, and trunk represent its explicit dimension, and the roots represent its tacit dimension. The explicit has to do with "know-*what*," and the tacit has to do with "know-*how*." The tacit lives in action—one *learns to be* by doing things with others.

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Universities can transform themselves into social learning organizations that foster students' progression from the explicit to the tacit by using virtual, Web-based learning opportunities to augment, but not replace, the physical. Online activities such as collaborative science experiments or Webcast lectures, annotated by a community of students, can strengthen the learning process. Such activities foster the social, conversational inquiry that builds the cognitive scaffolding to support the acquisition of knowledge.

Technology also makes it possible for higher education to extend its reach across time and space. For example, universities can form networks to maintain active relationships with alumni to help meet their lifelong learning needs. Given their involvement in a practicing community, most participants in a dynamic alumni network will become both learners and teachers, facilitating the capture of intellectual assets in the making. Across space, institutions can use technology to help form what Brown calls a *knowledge ecology*, one that reaches beyond the university's resources to draw on the strengths of the region's libraries and museums, as well as the contributions of the local citizens, students, firms, and government. Higher education's challenge and opportunity, Brown says, is to create new learning environments that use the unique capabilities of the Web to leverage the ways that humans learn.

The New Media Model

Woodie Flowers, Pappalardo professor of mechanical engineer-

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ing and MacVicar faculty fellow at MIT, describes his vision of higher education, one that helps meet the enormous educational challenges we confront on a global scale. He contrasts today's "cottage industry" model of nearly 3,800 two- and four-year colleges and universities in the United States with his proposed *new media model*. By "new media," Flowers does not mean distance learning or videotaped lectures. Rather, he envisions entertainment-quality, Web-based modules that use animation, voice and video clips, captions, and text, all combined as appropriate in accurate, well organized, pedagogically solid productions. Flowers is convinced of the superiority of such a highly produced module over any of the best lectures he has ever given.

Echoing the work of Resnick and Brown, Flowers notes that a key characteristic of new media educational material is the shift from merely conveying information about calculus, for example, to educating students to think about *using* calculus by applying concepts to interactive performances and demonstrations. The enhanced educational benefits of this "learning by doing" approach have been demonstrated in experiments. Further, the inherent nature of new media material allows for its continuous improvement: Because massive amounts of data will be available on how different users learn and on which techniques are effective, the modules will evolve rapidly. Unlike textbooks, new media modules could undergo literally hundreds of updates or editions.

New media material may best be used for what Flowers calls *commodity training*, that is, high-enrollment, largely introduc-

tory topics taught at the undergraduate level. They could effectively obviate typical freshmen courses, as well as many subsequent ones, which Flowers describes as training rather than education. What, then, should happen on campus? Residential programs should be used only for those aspects of an education that require presence. Training does not justify the cost of most university experiences. Education does. But sorting out just what requires residence, what it is about being in the same room with another person that helps learning, and when that matters most, is a challenging question for academia. If we can figure that out, we can greatly increase the efficiency and reach of higher education. Half the world's population is under age 20; we have essentially no hope of educating these young people by conventional means. New learning modules, however, can provide access to high-quality learning opportunities for a wide variety of students, the vast majority of whom will never have the luxury of a residence-based higher education.

As far as technology goes, we are closer to being able to produce the compelling and effective new educational media Flowers describes than most people realize. The essential factors for success will be commitment and cooperation among institutions to invest in the production of new media material, which could exceed \$20 million for a set of modules for any particular course. Such a cooperative effort would address the flaws and redundancies that seriously reduce the effectiveness and threaten the long-term viability of our current higher education model.

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Learning as Shared Understanding

Diana Laurillard, professor of educational technology and pro-vice-chancellor at the Open University, UK, believes that today's teaching methods have not evolved sufficiently for universities to fulfill their mission. She notes that the most important qualities graduates take with them to careers in today's knowledge industries are found not so much in the information or specific knowledge they have stored up, but rather in the skills, attitudes, and ways of thinking derived from their courses. Consistent with the themes stressed by other Internet Forum scholars, Laurillard advocates a radical shift from the standard transmission model, from teaching *what is known* to teaching *how one comes to know*. This entails engagement on many levels for both the individual and the learning community. Students' active participation with practitioners, working together on common projects, makes them part of the process of creating knowledge.

Laurillard outlines a *conversational framework* for learning based on a continually iterative dialogue between teacher and student and the constant interplay of theory and practice. The transmission model is just one part of this much more complex model for learning as shared understanding. The Open University's technology-based courses are all designed within the conversational framework. The learning objectives of the course, and not technology, drive course design. For each subject, the communicative, interactive, and adaptive capabilities of technology facilitate different types of iterative dialogue between

teachers and students. The practical exercises of investigating and analyzing resources and running simulations are combined with theoretical and conceptual discussions within the learning community, either synchronously or asynchronously.

Development of these courses requires an enormous commitment of time and resources, but there is little incentive for faculty to develop them. While research flourishes on our campuses, teaching languishes. Laurillard urges universities to realign research and teaching by adopting a professional approach to teaching that parallels that for research. She proposes a collective research and design effort to build tools that support students in learning the skills of scholarship. Until then, generic forms of technology-based courses that can be used across the full range of university curricula may offer a solution. Similar to the generic form of a book, a lecture, or a PowerPoint presentation, the teacher's task would be to customize the content. Relatively little programmer support would be necessary because the pedagogical design is already embedded in the generic form. Laurillard offers these forms as an alternative to the individual struggle to discover how best to take advantage of the powerful, but too often overwhelming, array of possibilities technology presents for improving teaching and learning.

Games and Education

The entertainment technology industry invests vast sums in research and development to create the advanced simulations,

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characters, and scenarios that underpin computer games. The US Army recognizes the transferability and learning potential of these games, collaborates with industry to create customized versions for a wide range of training purposes, and, ultimately, to generate realistic virtual experiences that will move military training a quantum leap into the future. Academia might also benefit from the model presented by online, multi-player, role-playing games (RPGs), in which networked environments foster active engagement and track participants' contributions. Colleges and universities could create environments with similar capabilities that use technology to capitalize on the strengths and learning styles of the "wired generation" to enhance teaching and learning.

Military Culture

Michael Macedonia, chief scientist and technical director of the U.S. Army Simulation, Training, and Instrumentation Command (STRICOM), and J.C. Herz, chief executive officer of Joystick Nation, Inc., describe the potential of entertainment technology to revolutionize teaching and learning. Macedonia reports that the U.S. military culture has accepted computer gaming as a powerful tool for remaking the armed forces in preparation for the new realities of the 21st century. The military recognizes that the young people who will serve as tomorrow's soldiers, sailors, and pilots have spent years immersed in technology. Army studies show that this cohort is very different in terms of skills and attitudes than its predeces-

sors. One characteristic of this wired generation is the ability to multiprocess, for example, to listen to music, talk on a cell phone, and use a computer at the same time. Another is a bias to action, to learn less from being given information and more as a result of discovery-based experiences. Further, the wired generation is developing a literacy that involves interpretation not only of texts, but also of images.

In light of these largely unique traits, the military has modified many commercial games to develop skills and to build teams, including Atari's *Battlezone* for the army, ID Software's *Doom* for the marines, and Microsoft's *Flight Simulator* for the US Navy. The navy now issues customized versions of *Flight Simulator* to all its student pilots. Further, the military considers simulation technology—that is, the creation of virtual experiences for training purposes—as a major strategic capability for the U.S.

The Department of Defense's goal is to leverage the huge investments that commercial firms pour into research and development in this field. Microsoft, for example, spent over \$2 billion on development of the X-Box alone, far surpassing the U.S. Army's entire science and technology budget of \$1.6 billion.

Online Environments

Herz focuses on the learning potential of networked environments illustrated by multiplayer, online RPGs. The social ecology of these networked games offers the opportunity for partic-

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Participants not only to compete, but also to collaborate, invent, and construct a networked model for learning and teaching the game. Multiplayer online games actively foster the formation of teams, clans, and guilds and allow players to stretch their experiences in new and unexpected directions. Nearly every game comes with a built-in level editor and tools to create custom characters or scenarios. RPGs' playing fields, or online worlds, persist whether or not an individual player is logged on at any given time. Players move in and out of the game, developing their character over a period of several months or years by overcoming challenges and accruing experience points.

In terms of the speed and volume of learning (the rate at which information is assimilated into knowledge and then synthesized into new forms), the networked ecosystem of online gaming is vastly more dimensional than the 19th century paradigm of classroom instruction. Players learn through active engagement, not only with software, but with each other as well. In universities, it is widely accepted that much learning occurs outside the classroom. Yet most online activities in higher education (for example, online syllabi, threaded discussions, and class e-mail) are not integrated in a coherent way. To be meaningful, the online environment should be structured so that participants actively engage in construction of their learning experiences and so that students are useful to one another.

Moreover, the system must acknowledge students' contributions. In the world of online games, that acknowledgement is quantified in various ways: Players know how many times their contribution has been downloaded and how it's been rated by

the community. This recognition fuels participation and invests the player in the experience because it transforms knowledge into social capital. Not only do players “own” their learning (because they had a hand in its construction), but that ownership is worth something in the social context where one’s status derives from peer acknowledgement, an incentive more powerful than grade-point average or teacher approval.

As higher education strives to transform itself through information technology, it is important to consider not only the hardware and software necessary to achieve that transformation, but also the cultural infrastructure necessary to leverage those resources. In this regard, multiplayer online games present a valuable model for higher education as both a means to build a networked learning environment and to leverage the technological skills of 21st century students.

Conclusion

At times the sheer scope of the possibilities for, as well as the expense of, launching technology-based initiatives appear overwhelming, yet the return for facing these complex issues and working through them to implementation is not to be underestimated. Higher education in the United States and throughout the world stands to benefit tremendously from adapting to and embracing new learning media. It is hoped that the ideas and visions shared in this book by the Internet Forum scholars can help colleges, universities, and others take

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full advantage of the opportunities and successfully weather the risks of rapid technological change.

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