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EXECUTIVE SUMMARY

Learning spaces of the 21st century need to foster discovery, innovation, and scholarship, and not simply contain them.

— Malcolm Brown & Phillip Long
Learning Spaces

Overview

In preparation for planning new Higher Education projects, we recommend that you read these six recent articles that focus on transformation in higher education driven by changing student expectations, evolving pedagogies, and new technologies.

Drawn from academic and professional research, as well as authored by several of The Sextant Group’s principals, these articles look at the contemporary campus, the expectations of post-millennial students, and the issues architects and designers are facing in planning for new buildings, new classrooms, and the ancillary spaces needed for new learning environments.

These studies provide a basis of understanding, which should stimulate ideas and help facilitate the dialogue during the workshop. Our goal for the planning session is to help co-create new learning spaces by focusing on “what could be” not just “what is.”

Section Summaries

In Active Learning Transforms Environments, Nancy Sturm, principal consultant at The Sextant Group, examines the shift toward collaborative student/faculty relationships made easily accessible by online resources and wireless connectivity. This shift creates an opportunity to everyone engaged in the architectural design for new and renovated academic facilities.

In Designing for Blended Learning, from Educause’s e-book, Learning Spaces, Andrew Milne of Tidebreak, looks at technology and its implications to the student experience.

Educause’s learning initiative study, Flipped Classroom, looks at the pedagogical model in which the typical lecture and homework elements of a course are reversed, its significance and implications.

In The Age of Collaboration, Craig Park, principal consultant at The Sextant Group, reviews the space and technology considerations for communication without boundaries: the use of distance learning and media capture to engage students (and faculty) anywhere in world. For those planning new or renovated collaboration spaces, design issues of ergonomics,

New and Enhanced Learning Environments, written by The Sextant Group president, Mark Valenti and vice president, John Cook, is one of twenty New Directions in Planning essays, that are a companion to the 2008 book, A Guide to Planning for Change, published by The Society of College and University Planners (SCUP).

The Single Most Important Experiment in Higher Education by Jordan Weissmann (Atlantic Magazine, July 2012) describes how massive open online courses, like the new education platform Coursera, are transforming elite education in the 21st century.

Next Steps

A Technology Visioning workshop, delivered by one of The Sextant Group’s Principals can begin the process with an overview of emerging trends— supported by information similar to that you will find herein— and then transition into breakout sessions that will look at the implications of the student of the future, the faculty of the future, and the campus of the future on the design for your new project.

We look forward to working with you in this exciting process.
Emerging Technologies & Implications

Key Trends
When looking at potential emerging technologies in college and university education, it is important to study the context in which that technology fits. According to the 2012 Horizons Report, published by the New Media Consortium, several key drivers of educational technology adoptions for the next five years and the trends associate with them.

1. People expect to be able to work, learn and study whenever and wherever they want to.
2. The technologies we use are increasingly cloud-based, and our notions of IT support are decentralized.
3. The world of work is increasingly collaborative, driving changes in the way student projects are structured.
4. The abundance of resources and relationships made easily accessible via the internet is increasingly challenging us to revisit our roles as educators.
5. Education paradigms are shifting to include online learning, hybrid learning and collaborative models.
6. There is a new emphasis in the classroom on more challenge-based and active learning.

Significant Challenges
When we investigate disruptive technologies and how they fold into already established routines there will be challenges and constraints. The HMC Horizon’s report cited several challenges that leaders in higher education need to review:

1. Economic pressures and new models of education are bringing unprecedented competition to the traditional models of higher education.
2. Appropriate metrics of evaluation lag the emergence of new scholarly forms of authoring, publishing, and researching.
3. Digital media literacy continues its rise in importance as a key skill in every discipline and profession.
4. Institutional barriers present formidable challenges to moving forward in a constructive way with emerging technologies.
5. New modes of scholarship are presenting significant challenges for libraries and university collections, how scholarship is documented, and the business models to support these activities.

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1 The New Media Consortium (NMC) is an international community of experts in educational technology — from the practitioners who work with new technologies on campuses every day; to the visionaries who are shaping the future of learning at think tanks, labs, and research centers; to its staff and board of directors; to the advisory boards and others helping the NMC conduct cutting edge research. For more information see www.nmc.org
Technologies to Watch

The HMC Horizons report highlights six technologies and indicates they will have major impacts in teaching and learning in higher education. The timeline for implementation of these technologies is divided into three phases: Near-Term (next 12 months), Mid-Term (2-3 years out), and Far-Term (4-5 years out). Be advised that all that are listed are currently employed on innovative campuses across the country.

Near-Term Horizon

- **Mobile Apps:** This technology has the greatest impact and will influence every discipline. The following links will provide examples of mobile apps in use higher education settings:
  - Berkley Mobile International Collaborative ([go.nmc.org/pramk](http://go.nmc.org/pramk))
  - iPrinceton ([go.nmc.org/oadcp](http://go.nmc.org/oadcp))
  - Stanford University’s iphone and ipad Apps Course ([go.nmc.org/tvlvs](http://go.nmc.org/tvlvs))

- **Tablet Computing:** Tablets provide an array on new solutions that have far-reaching effects we have yet to even know. With the introduction of e-books along with numerous of applications they feature a wide variety applications for students and faculty.
  - The iPad Replaces University Textbooks ([go.nmc.org/vblpb](http://go.nmc.org/vblpb))
  - University of Dayton Undergraduate Viewbook ([go.nmc.org/ctjzq](http://go.nmc.org/ctjzq))

Mid-Term Horizon

- **Learning Analytics:** Research continues in this area to assist in redesigning curricula, teaching and assessment to meet the needs of students today. Using Google Analytics as well as other data mining tools, the college campuses experiences continues to evolve.
  - CoreDogs ([go.nmc.org/bypup](http://go.nmc.org/bypup))
  - Learning Catalytics ([go.nmc.org/mymtv](http://go.nmc.org/mymtv))

- **Game-Based Learning:** The popularity of this trend continues to grow in many educational disciplines. As we focus more on collaboration and engaging students, the potential of using games for those skills increases.
  - 3D Game Lab ([go.nmc.org/vedmb](http://go.nmc.org/vedmb))
  - GAMES Lab at Radford University ([go.nmc.org/qlohz](http://go.nmc.org/qlohz))
  - Games and Learning: Teaching as Designing ([go.nmc.org/cooar](http://go.nmc.org/cooar))

Far-Term Horizon

- **Gesture-Based Computing:** Direct interaction with technology is changing how we work and play. As these devices become more intuitive, our interaction with them increases both physically and mechanically.
  - Art and Fashion Design ([go.nmc.org/bnkwk](http://go.nmc.org/bnkwk))
  - Science and Medicine ([go.nmc.org/edaic](http://go.nmc.org/edaic))
  - Zero Touch at Texas A&M ([go.nmc.org/xpsge](http://go.nmc.org/xpsge))

- **The Internet of Things:** The relationship drawn between physical objects and digital information is increasing. With the popularity of internet-enabled phones, appliances, picture frames and office equipment, we can only imagine the impact this will have.
  - NYU’s Sensitive Buildings Class ([go.nmc.org/nhqf](http://go.nmc.org/nhqf))
  - Penn State Behrend’s RFID Center of Excellence ([go.nmc.org/kxwlh](http://go.nmc.org/kxwlh))
ACTIVE LEARNING Transforms Environments

By Nancy Sturm, Principal Consultant, The Sextant Group

Change is in the air. Universities are rethinking the educational experience, watching technological innovations and building learning spaces that are challenging the traditional teaching methods on campus. Changes in pedagogy, student expectations, campus culture, and corporate competition are resulting in fundamental shifts of mission, culture and process at many institutions. Colleges and universities recognize that to meet the needs of today’s students, higher education must examine teaching and learning through a new lens.

As learning is moving more and more outside the walls of traditional classrooms, different approaches must be considered. Content and context of material is being delivered in homes, cars, coffee shops, and on personal mobile devices. Learning needs to become situated, personal, collaborative, and lifelong to meet the needs of today’s students. Delivery and facilitation of learning requires new educational approaches that have a core strategy of re-thinking and re-structuring. The forces that are converging to bring this transformation to life are: economic trends, learning spaces, course redesign and faculty adoption.

Economic outlook is a real concern on college campuses today. As tuition cost continues to rise and financial support shrinks, institutions both public and private recognize that they cannot continue to do business as usual. They must become creative in applying technology to deliver a higher quality learning experience for less money. With demand continuing to increase and pressure to improve value they must look at how they can deliver more services without putting strains on current real estate.¹

Aligned with economic assumptions comes the need to look at learning spaces with a new view. Digitally motivated students will not settle for lecture halls where “stand and deliver” is the preferred pedagogical choice. As a result of this movement, different kinds of learning spaces (both new and renovated²) are popping up at universities around the country that change the face of teaching and learning. Over 100 universities have developed their own studio-based active classrooms.³ Examples include TEAL at MIT⁴, TILE Classrooms at the University of Iowa⁵, Active Learning Classrooms at the University of Minnesota⁶, and SCALE-UP at NCSU⁷. The Lucas Expansion Educational Program (LEEP) was Stanford University’s first foray into such
spaces, and the University of Virginia’s Medical Education learning studios are among the newest to come on-line in 2011.

"One of the goals of this whole model—of having students do a lot of the learning themselves rather than passively listening—is that they need to be lifelong learners."

- Randolph Canterbury, Senior Associate Dean for Education, University of Virginia

When you walk into these rooms you see and feel a difference. They have been specifically created to facilitate active, collaborative learning. They promote interactions between groups of students. There may not be a “front of the room.” Conversation and collaboration are happening everywhere. A decade of research indicates these new approaches to educating students are improving student outcomes and reducing delivery cost for institutions. Research in the science of learning indicates that active learning is one of the most important and essential components in the learning process. In How People Learn, John Bransford and his colleagues explain that when students are actively engaged in their learning process and when they can apply what they have learned they retain knowledge.

Active learning classrooms focus on social interactions between students and faculty. “What Matters in College” author Alexander Astin explains that the relationships students build with each other and with faculty is the most important outcome of their four year experience. Active learning classrooms are filled with hands-on activities, simulations, or essential questions and problems where students work as a team to solve real life issues. Most importantly the traditional notion of classroom is flipped: “what used to be homework happens in the classroom and what used to happen in the classroom becomes homework.”
Trends in availability of online technologies and research on how we learn all seem to support the growth of blended learning concepts and are driving the crusade of course redesign. The National Center for Academic Transformation (NCAT)\textsuperscript{xii} is a forward thinking not-for-profit organization that is assisting campuses with course redesign. NCAT’s approach brings together face-to-face activity with web-based content in a planned, pedagogically valuable manner and is referred to as blended learning. It provides today’s students with anytime, anywhere convenient access to materials and blends synchronous and asynchronous instruction to offer new approaches to educational delivery and facilitation.

BL is considered an effective and low-risk strategy which helps position universities for the onslaught of technological developments that will arrive in the future. It increases the options for greater quality and quantity of human interaction in the learning environment. Student can learn the way that suits them best: on their own time, at their own pace, in their own place, using the tools with which they are most comfortable. In providing new and more flexible educational strategy students have opportunities to review course material and communicate with peers and instructors with tools they are familiar with. As we look to improving the learning environment in higher education we must convert teaching from a solo endeavor to a community-based research activity. Because of the different modes of delivery BL meets the educational needs of a much large audience. Key baselines to consider with blended learning are: learning outcomes, student satisfaction, retention and achievement.

NCAT case studies show examples of the success of this model. A recurring theme from the research is that by redesigning courses universities can reduce cost and teach more effectively. SUNY Buffalo’s course Economics 101 saw significant increase in student learning outcomes and improved student success rates from 67% to 76% and reduced costs by 46% by doubling section size.\textsuperscript{xiii} A team of faculty, administrators and technology experts at Frostburg State University redesigned their General Psych course and again significantly increased student performance while reducing instructional costs by 71%.\textsuperscript{xiv} Mississippi State showed a cost savings of 25% per student.\textsuperscript{xv}

These are remarkable outcomes that are forcing colleges to look seriously at real transformation. Further studies can provide a more comprehensive understanding of blended learning in course redesign and its potential in education but many universities recognized the need for change and that this solution can be very effective. Susan Patrick, president and CEO of International Association for Online Learning agrees with this analysis. She said the advantage of blended learning over just face-to-face instruction “is the combination of rich student-teacher-peer
communication and interactions that are both asynchronous and synchronous, better utilizing precious resources of time during, and outside, the school day to maximize learning-and personalize it in a way never before possible."

Susan goes on to state that the factors needed to make blended models better than face-to-face models are the factors that research says also define good teaching: "increased interactions between students and teachers, increased depth of rigor and exploration into content, customized learning to meet the students exactly where they are in the learning the material, better use of data to inform instruction, and providing additional student support to help personalize instruction by the instructor." xvi

The US Department of Education report "Learning on Demand-Online Education in the US" states that online enrollments have continued to grow at rates far in excess of the total higher education student population. The economic situations have increases demand for new online courses by 66%.

As we look at tomorrow’s opportunities for delivering the highest quality student educational experience at our universities, blended learning initiatives usher in a new paradigm of education and provides a model for enhanced student-faculty interaction. A close look at the learning and teaching relationship that facilitates a community of inquiry and builds upon cognitive, social and teaching presence is at the heart of this pedagogical approach. A theme of engaging, enabling and empowering learning must replace traditional approaches to meet the needs of our wired students who expect to be able to work, learn, and study whenever and wherever they want.

The abundance of online resources and the shift toward collaborative student/faculty relationships made easily accessible wirelessly anywhere on campus is driving educators to revisit their roles. In turn, this creates a challenge to everyone on engaged in the architectural design for new and renovated academic facilities. This shift in thinking is a policy that leadership must endorse for transformation to take place. Is your organization ready for this change?

ABOUT THE AUTHOR

Nancy Sturm is a principal with The Sextant Group, and is based in the Washington DC area. Nebraska. A nationally-recognized thought leader in the application of Educational Technology, Nancy is an award-winning educator and education technologist with over 20 years of experience in program
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Scenario

For the past two weeks, Kyle has been taking a flipped course in designing food gardens. Before he attends each class, he watches videos of short lectures recorded or recommended by his instructor. Each lecture comes with a brief online quiz that offers him immediate feedback on whether he missed any essential points. Today as he enters class, he glances at the schedule on the whiteboard. For the first half hour, teams will discuss how the content of the video lectures on microclimates, insect predation, and disease control will inform their team projects. Professor Dalton circulates among the tables to see if anyone has questions.

Kyle’s team will be repurposing an area the size of an urban backyard into a visually appealing garden that is also a functional food source. It’s part of the larger class project to reclaim a strip of city land by building a demonstration food garden. “I think we should bring in disease-resistant blueberries, grapes, and pome fruits,” says Coleen, looking at the rough drawings they have made so far. Dalton stops to look over their design. “Check the nursery catalogs on the front table,” he suggests. “Disease-resistant strains are clearly marked in their listings.” As they search the catalog and discuss which diseases might be a problem in dwarf apples, pears, blueberries, and grapes, Kyle enters their cultivar choices in their Google Docs space. They are turning to a discussion of microclimates and plant placement when a chime signals discussion is over.

In the second half of the class, team monitors each retrieve two flat boxes from the front of the class. One box contains a stack of pins and various leaves preserved in plastic. The second box has a foam insert topped by a paper grid; each square is labeled with a nutritional deficiency or a disease common to food plants. During the next half hour, each team is to identify the disease or nutritional deficiency and pin the correct leaf in the right spot on the grid. Dalton is on hand, directing attention to clues and sometimes challenging their choices.

As he leaves, Kyle reflects that the hands-on activities have given him a far better grasp of the information and more confidence in what he has learned than he could have gotten from an in-class lecture.

What is it?
The flipped classroom is a pedagogical model in which the typical lecture and homework elements of a course are reversed. Short video lectures are viewed by students at home before the class session, while in-class time is devoted to exercises, projects, or discussions. The video lecture is often seen as the key ingredient in the flipped approach, such lectures being either created by the instructor and posted online or selected from an online repository. While a prerecorded lecture could certainly be a podcast or other audio format, the ease with which video can be accessed and viewed today has made it so ubiquitous that the flipped model has come to be identified with it.

The notion of a flipped classroom draws on such concepts as active learning, student engagement, hybrid course design, and course podcasting. The value of a flipped class is in the repurposing of class time into a workshop where students can inquire about lecture content, test their skills in applying knowledge, and interact with one another in hands-on activities. During class sessions, instructors function as coaches or advisors, encouraging students in individual inquiry and collaborative effort.

How does it work?
There is no single model for the flipped classroom—the term is widely used to describe almost any class structure that provides prerecorded lectures followed by in-class exercises. In one common model, students might view multiple lectures of five to seven minutes each. Online quizzes or activities can be interspersed to test what students have learned. Immediate quiz feedback and the ability to rerun lecture segments may help clarify points of confusion. Instructors might lead in-class discussions or turn the classroom into a studio where students create, collaborate, and put into practice what they learned from the lectures they view outside class. As on-site experts, instructors suggest various approaches, clarify content, and monitor progress. They might organize students into an ad hoc workgroup to solve a problem that several are struggling to understand. Because this approach represents a comprehensive change in the class dynamic, some instructors have chosen to implement only a few elements of the flipped model or to flip only a few selected class sessions during a term.

Who’s doing it?
A growing number of higher education individual faculty have begun using the flipped model in their courses. At Algonquin College, a video production class has been using this model to explain the workings of editing software, a procedure that is notoriously difficult to explain in a standard lecture. Short tutorial video lectures let students move at their own pace, rewind to review portions, and skip through sections they already understand.
meaning students come to class able to use the software and prepared to do creative projects with their peers. A particularly successful example of a blended and flipped class in accounting at Penn State accommodates 1,300 students. In-class time is used for open discussion, a featured guest speaker, or hands-on problem solving where instructor support is supplemented by student assistants. At Harvard University, one physics professor not only employs the flipped model but has also developed a correlative site, Learning Catalytics, that provides instructors with free interactive software enabling students to discuss, apply, and get feedback from what they hear in lecture.

Why is it significant?
In a traditional lecture, students often try to capture what is being said at the instant the speaker says it. They cannot stop to reflect upon what is being said, and they may miss significant points because they are trying to transcribe the instructor’s words. By contrast, the use of video and other prerecorded media puts lectures under the control of the students: they can watch, rewind, and fast-forward as needed. This ability may be of particular value to students with accessibility concerns, especially where captions are provided for those with hearing impairments. Lectures that can be viewed more than once may also help those for whom English is not their first language. Devoting class time to application of concepts might give instructors a better opportunity to detect errors in thinking, particularly those that are widespread in a class. At the same time, collaborative projects can encourage social interaction among students, making it easier for them to learn from one another and for those of varying skill levels to support their peers.

What are the downsides?
The flipped classroom is an easy model to get wrong. Although the idea is straightforward, an effective flip requires careful preparation. Recording lectures requires effort and time on the part of faculty, and out-of-class and in-class elements must be carefully integrated for students to understand the model and be motivated to prepare for class. As a result, introducing a flip can mean additional work and may require new skills for the instructor, although this learning curve could be mitigated by entering the model slowly.

Students, for their part, have been known to complain about the loss of face-to-face lectures, particularly if they feel the assigned video lectures are available to anyone online. Students with this perspective may not immediately appreciate the value of the hands-on portion of the model, wondering what their tuition brings them that they could not have gotten by surfing the web. Those who see themselves as attending class to hear lectures may feel it is safe to skip a class that focuses on activities and might miss the real value of the flip. Finally, even where students embrace the model, their equipment and access might not always support rapid delivery of video.

Where is it going?
As the flipped class becomes more popular, new tools may emerge to support the out-of-class portion of the curriculum. In particular, the ongoing development of powerful mobile devices will put a wider range of rich, educational resources into the hands of students, at times and places that are most convenient for them. Greater numbers of courses will likely employ elements of the flipped classroom, supplementing traditional out-of-class work with video presentations and supporting project-based and lab-style efforts during regular class times. At a certain level of adoption, colleges and universities may need to take a hard look at class spaces to ensure they support the kinds of active and collaborative work common in flipped classes.

What are the implications for teaching and learning?
The flipped classroom constitutes a role change for instructors, who give up their front-of-the-class position in favor of a more collaborative and cooperative contribution to the teaching process. There is a concomitant change in the role of students, many of whom are used to being cast as passive participants in the education process, where instruction is served to them. The flipped model puts more of the responsibility for learning on the shoulders of students while giving them greater impetus to experiment. Activities can be student-led, and communication among students can become the determining dynamic of a session devoted to learning through hands-on work. What the flip does particularly well is to bring about a distinctive shift in priorities—from merely covering material to working toward mastery of it.
The Emerging Student Experience

What we think of as cutting-edge learning technologies today differ significantly from just a decade ago. Students themselves are changing, too, as their practices are shaped by the technological environment. A majority of today’s college students would probably not first associate cut-and-paste with scissors and glue; for them technologies like digital cameras have always existed. And yet the processes we use to develop technology-enhanced learning spaces have not changed significantly in the past several decades. This chapter explores the space design process in the context of today’s technological landscape and suggests ways the process can change to become more effective.

Student Characteristics

Developing a realistic, detailed sense of the student experience is an important starting point to the design process. A former director of the Open University in Scotland once observed, “It has taken me 20 years as an educator to realize what was obvious to me as a student.” His comment underscores the fact that needs-finding activities are important in understanding the student experience at any particular campus. A few trends are worth considering here.

- **Classrooms are not the only form of learning space.** While the classroom is assumed to be a primary location of learning, data suggest that a majority of student learning activity takes place outside the classroom.

- **Social interaction is a growing part of learning.** Evaluation methods and performance metrics emphasize individual effort and achievement, but
students increasingly are motivated by social interaction with their peers. Pedagogy is shifting to emphasize team activities and collaborative learning.

- **Technology is natural.** Computer and networking technologies that once might have appeared exotic (pervasive wireless networking, iPods, smart phones) or transformative are now considered mainstream. While “digital immigrant” faculty may perceive these technologies as a new part of the educational landscape, “digital native” students see them as a natural component of their lives.

- **Internet resources can bypass peer review.** Traditional publication processes involved vetting and validating information, but the Web enables near-instantaneous distribution of information without formal review. It becomes increasingly important, then, for students to interact with one another and with faculty to analyze and critique online resources.

- **Learning can occur out of sequence.** Although lectures, books, articles, and other traditional tools present information in a deliberate, sequential manner, today’s students are comfortable with overlapping discussion threads and parallel activities that may span different types of media, devices, and communities.

- **Students construct content rather than just consuming it.** Students are active authors of content, including video documents, online blogs, and other forms of digital expression. Whether delivering a final report or going online to converse with members of an online community, today’s students have a range of digital devices and software tools that allow them to create and shape content.

These trends emphasize that learning is becoming more social and informal and less structured. In contrast to the character of formal lecture halls and classrooms, modern learning space design seeks to provide freedom of access and interaction with peers. From a physical point of view, these places are increasingly conceived as comfortable, flexible spaces in which groups can interact and collaborate. Successful integration of technology and physical design into these kinds of spaces requires an understanding of emerging technology interfaces and new design approaches.

**Current Conceptions of Learning Technology**

Even among IT professionals, it is common to refer to technology in a general way, as if it were a specific type of system. In reality, the term “learning technology” encompasses a wide range of devices, software products, and user experiences.
Acknowledging the differences is a first step toward understanding the relationship between learning technologies and physical space design. Learning technologies fall into six categories.

**Virtual Technologies**

- **Online presence.** These technologies support an online presence, either through real-time interaction or asynchronous personal repositories. They include e-mail (often with multiple addresses), Web sites, blogs, wikis, e-portfolios, instant messaging (IM), short message service (SMS), Skype, Flickr, and podcasts.
- **Online resources.** Online resources include Google, courseware management systems, electronic databases, digital libraries, and online publications. They provide access to resources that are public, not personal, in nature.

**Installed Appliances**

- **Media presentation systems.** Many classrooms or seminar rooms have devices that allow playback of media of varying formats. Among these are the videocassette recorder, DVD player, document camera, and slide-to-video unit.
- **Remote interaction systems.** Recent improvements in broadband and streaming technologies have made real-time interaction possible. Examples include videoconferencing, Web cameras, and application-sharing suites.
- **Room-scale peripherals.** A new class of devices has begun to emerge that support group interaction. Interactive displays, whiteboard capture systems, and room schedule displays fall into this category.

**Mobile Devices**

- **Personal information and communication devices.** Mobile technologies such as laptops, cell phones, PDAs, Tablet PCs, iPods, digital cameras, Wi-Fi finders, USB drives, and GPS systems are part of our personal communication culture.

As indicated, these technology categories fall into three clusters: virtual technologies not tied to particular physical hardware; installed technology appliances that include a specific physical instantiation; and mobile devices. We experience all of these technologies in physical contexts. The challenge is to codesign technologies in a way that addresses both the physical and interactive dimensions in a symbiotic way.
The Need to Focus Design on the Student Interface

The recent interest in learning space design among IT professionals reflects a growing realization that the most interesting opportunities lie at the endpoint of computing networks—the interface between students and technologies. The combination of mobile students and mobile technologies highlights virtual spaces, but in truth these technologies are part of a blended environment. Ubiquitous computing embeds technology within the fabric of the physical environment, creating opportunities for nontraditional human-computer interfaces. Figure 1 illustrates the point that physical context shapes the interface to virtual spaces; the experience of using virtual spaces changes depending on the nature of the physical space from which one or more people access it.

Consider, for example, a group of students sitting together in a team study room using Web-based tools. Their physical context will consist either of each student having a personal copy of the tool (for example, a Web-based collaboration tool) or having a shared copy of the tool. The physical context will shape the virtual experience.

Figure 1. The Varied Nature of Blended Learning Environments
environment) open on a laptop, or all the students crowding around one screen giving verbal commands to one person at the keyboard. The students either work in semi-isolation or all of the group’s interactions are filtered through one individual. Neither case represents an ideal interactive group process because the technology forces a particular mode of interaction. For group work, students are using an interface (the laptop) designed for individuals. A new class of group-based technologies is just beginning to be deployed at academic institutions to provide a more appropriate interaction experience (see chapter 35 in this book on GroupSpaces at Stanford University). Such technologies present the potential for new opportunities, but they also fall outside conventional thinking about learning space design.

Creative opportunities lie at the interface between virtual and physical worlds. New physical architectural styles and embedded interactive technologies will support an evolving set of work styles. Institutions will need new human-centered planning, design, and deployment approaches that embrace flexibility and constant change. Learning space development will require iterative design and prototyping methods, a departure from traditional design practices that will require significant process realignment.

The Disconnect Between High-Tech Learning Spaces and Current Design Practice

Learning spaces have traditionally been developed on campuses primarily as part of capital planning projects for new building construction or renovation of existing structures. Building design follows a standard set of phases that has not changed significantly in the past 20 years, even though the nature and prevalence of technology-enabled spaces is dramatically different. Analyzing the way these projects are managed provides insight on how design processes might evolve to accommodate new forms of technology and philosophies of learning space.

Traditional Institutional Spending Practices

Major learning space design projects and their associated technology design efforts can effect significant transformations on a campus. Four major types of learning spaces commonly appear in major projects: classrooms, computer labs, informal learning spaces, and equipment rooms. It is instructive to examine how standard design processes handle these categories of space.
Classrooms
Technology-enabled classrooms are the most identifiable learning space. To date, most of the technologies incorporated into classrooms emphasize a presentation mode of instruction. Videoconferencing and Webcasting systems that have begun to appear in classrooms perpetuate the notion of faculty as presenters and students as audiences. Even advanced classroom concepts such as the “black box theatre” implicitly suggest a performance modality. Recent moves to bring room-scale peripherals into these environments have created silos of technology that don’t interoperate or provide a well-integrated experience across devices. Among technology-enabled learning spaces, the truly interactive classroom can be a rarely achieved ideal.

Technology-enabled classroom systems can range in cost from $5,000 to $300,000, depending on the level of sophistication. Classroom technologies often belong to a capital building budget, but they are not necessarily considered basic to a building. A separate allowance typically goes into the furnishings, fixtures, and equipment (FF&E) budget or into a special budget to account for equipment and software costs. The FF&E budget, however, is frequently an early casualty of value engineering (specifically, cost cutting) efforts as a project moves forward and costs escalate. As a result, classroom technology funds are at the mercy of costs in a construction or renovation project. The funding model and their nature—highly customized systems designed as a part of large projects—typically mean no formal mechanism provides for the redesign of classroom systems as they age, despite the fact that pedagogical approaches change and available technologies evolve over time.

Computer Labs
Computer labs originally provided individual computer workstations and expensive or specialized software applications for student use; information commons and multimedia studio facilities are recent variants of this category. The need to provide baseline computing hardware has declined as more students bring their own computers to campus, although the need to provide specialty software remains. At a growing number of institutions, computer labs are being reconceived as places where student teams gather to work on group projects.

Computer labs do not require the customized cabling systems and equipment typically found in classroom technology systems. Hardware changes consist primarily of performance upgrades, with many enhancements implemented through
software. As a result, renewal of the technology systems in these spaces is a well-understood process with institutional support. Budgets to fund this renewal recognize it as a recurring expense, with upgrades typically deployed on a three- or four-year cycle.

**Informal Learning Spaces**
Informal learning spaces are important on campuses today as a result of:
- Widespread wireless access to the campus network and online resources
- Increasing student laptop ownership levels
- The realization that a majority of learning activities take place outside formal classroom environments

Informal learning space design is rapidly becoming a primary focus of interest and innovation.

This category suffers a number of challenges relative to others discussed here. Informal spaces are rarely explicitly included in a capital building project, in contrast to classrooms and other formal spaces. Informal spaces are typically not owned by any particular department or constituent group; thus, they often lack technological services, with the exception of wireless. Informal learning spaces also suffer from a lack of precedent—relatively few examples of planned informal spaces exist to use as models, although the number is increasing.

Personal computing devices owned by students (laptops, smartphones, iPods, digital cameras) find their way into formal and informal spaces. If institutions successfully leverage these devices in conjunction with installed technology systems, financial resources used to support traditional computer labs could be repurposed to create new forms of informal learning spaces. (See, for example, chapter 8 on Emory University’s Computing Center at Cox Hall.)

**Equipment Rooms**
The technical infrastructure that supports campus services includes networking hardware, server systems, and software packages. It continues to evolve with the advent of voice over IP (VoIP), wireless networking, and emerging technologies. These spaces are probably the best understood in terms of function and content, yet perhaps not as recognizable as a learning space. This infrastructure, while often invisible to students, is essential to learning spaces, both virtual and physical. Despite its importance, the cost of supplying network infrastructure for learning spaces is not always fully covered under the base building budget. If not built
The Importance of Architecture in Defining Learning Space

A primary focus of architectural design is the macroscopic aspects of a building—the physical form of the building structure itself, including its exterior character, its dimensions, and the adjacencies of its interior spaces. While a design team specifies interior elements such as lighting systems and interior finishes, the selection of furnishings typically occurs at the end of the project, using whatever FF&E funds remain.

Students and faculty, however, experience building design at a personal level. They interact directly with the chairs and tables, look for convenient power outlets to connect their laptops, and view a projected image from a particular location in a classroom. Yet while these personal elements significantly influence the users’ experience of the space, they are not a major focus of the design process.

Technology adds even more complexity. In today’s world, the character of our workspaces is defined not only by passive elements and patterns of use but also by the nature of dynamic digital content with which we interact in these spaces. The character of space is defined by a total experience; it is the combination of physical design and behavioral norms—and, more recently, technology interfaces—that define place. Learning space design processes have not yet caught up with the implications of these new technologies.

The Nature of Facilities Design at Academic Institutions

Campus building design and construction is often managed by a facilities planning group. The design and construction process follows standard phases sanctioned by the American Institute of Architects, specifically, schematic design, design development, construction documents, bidding and negotiation, and construction contract administration. In some projects, key members of an institution’s building committee visit other campuses to explore best practices, but these visits usually take place outside the formal design process.

The fee structure for design services has evolved to conform to this process even though information technology considerations have added complexity to the design. Since capital project spending typically requires board approval or...
is managed by state construction offices, budget guidelines leave little room for changes to the project scope. In addition, most capital building projects are subject to external schedule pressures that compress timelines to their shortest possible duration, leaving little time to spend developing an understanding of user needs. The needs discovery process is usually limited to a few meetings where future building occupants share their perceived needs and respond to questions from the design team.

In this process, questions about learning technology requirements are often posed in meetings that simultaneously attempt to cover a range of physical design topics. Most data about technology needs is self-reported, making information about daily activity and future practices prone to error. The stakeholders participating in these sessions are primarily faculty and staff; student involvement is minimal. As a result, the design team receives limited information about how learning spaces are used.

The technology systems design work lags the construction process to account for rapidly changing technology. System design work can start several years before implementation, however, since systems design is integrated with the early project planning. While there may be a refresh effort during the project, an opportunity to completely revisit the design rarely arises. Clearly, new processes are needed, more attuned to evolving technology and contemporary design challenges.

The Role of Technology Consultants
The technology consultant can play a critical role in space design by interpreting the institution’s needs and specifying systems that will address them. A consulting firm might have specialties in data networking, communications, cabling design, and audio-video systems.

Audio-video is the technology most often considered in learning spaces, yet the palette of audio-video products is limited in that it emphasizes presentation. Even the most sophisticated systems primarily tend to let faculty select audio-video signals from a variety of media playback devices. This reinforces a lecture paradigm rather than enabling students to interact directly with digital content in an ad hoc manner.

New technologies that are beginning to emerge move information between devices across standardized network infrastructures. Ultimately, learning space technology systems will consist of integrated software modules that run on an array of component hardware devices, in contrast to today’s systems of highly
specialized devices and customized cabling. A new class of technology design services will be needed, delivered by consultants who are well versed in “user experience” design and observant of evolving student work patterns. As learning space systems evolve toward all-digital interactive media tools, these consultants and the academic constituencies they serve will codevelop opportunities for new forms of interactive learning experience.

Moving Forward: A “Design Thinking” Approach
Design outcomes reflect the process by which they are derived. Just as the nature of technology integration in physical learning environments is changing, space design processes need to change to achieve innovative, blended learning places as the end result. These outcomes will grow from a culture of sustained design thinking that embraces the notion that flexible learning spaces remain permanently unfinished\(^{16}\) in their physical design as well as their technological fit-out. Some first steps in that direction are presented here.

Augment Self-Reported Design Requirements with Direct Data Collection
Effective design processes start with a needs-finding phase that crafts the vision for the final design. Research data that relies on self-reporting from subjects rather than direct observation is inherently biased. A first step in designing improved learning space is to augment the interviews with information collected about students’ daily activities.

Ethnographic-style observational studies, although a desirable approach, can be time-consuming and costly. Alternative techniques that leverage student involvement include student photo surveys coupled with journal entries\(^ {17}\) or multimedia blogging that encourages students to discuss their daily activities and record snippets of their experiences over a period of time. Another technique involves the development of surrogate student profiles, in which workshop participants define a collection of detailed student profiles that represent a cross-section of the student demographic, and then use these as a basis for imagining the specific needs of each fictitious student. Ultimately, learning space technologies may include integrated instrumentation that will automatically collect and deliver anonymous usage statistics that institutions can use in conjunction with observational methods to assess the impact of new environments on an ongoing basis.\(^ {18}\)
**Initiate Active Prototyping Programs**

Existing design practice has an unfortunate byproduct: learning space technologies typically are purchased and deployed in a single linear process. Building committees often make decisions about what technologies to deploy throughout a new building without having an opportunity to try them on a more limited scale. A better approach would establish an ongoing program of structured prototyping and evaluation that iteratively tests new ideas and technologies in a series of experimental and then operational settings. Prototypes provide tacit knowledge not available in a theoretical design. In the near term, prototyping might take the form of *critical function prototypes*, in which a particular capability or subsystem is deployed and tested early in the design process or while the building is under construction. Feedback from this trial would then influence the system design work later in the project life cycle.

In the long term, more substantial changes are needed. Sustainable prototyping programs funded through augmentation of operating budgets will permit explorations not limited to specific building projects. This will enable the creation of permanently unfinished spaces that would become test beds for new technologies and approaches. Institutions can begin by designating a small portion of the building technology budget for prototyping while the structure is being erected. Over time, this kind of activity could be leveraged across collaborating institutions, so that costs and best practice results could be shared. Successful design approaches will integrate ongoing needs analysis and prototyping activities. (See Figure 2.)

**Figure 2. A Revised Design Process**
Practice Truly Participatory Design
The lack of long-term, meaningful student involvement in building design projects is common. Although a student or two may be invited to join a committee to represent the interests of the entire student population, this seriously underrepresents a group that constitutes the majority of those who use learning spaces on a daily basis. Because of the lack of student representation, groups typically responsible for learning space design risk making decisions with a limited perspective on the total life of learning spaces.

To promote a more participatory design process, students, faculty, staff, and design professionals should be engaged in the kinds of needs-finding and prototyping efforts described earlier. Design teams could also facilitate design workshops, or charrettes, that provide a focused opportunity to explore ideas and develop a sense of design priorities, both in terms of specific design requirements and the more ephemeral aspects of the design intent.

In the future, design teams will evolve to include individuals with expertise in blended environments that address human interaction issues in terms of physical design and technology interfaces. These teams will not only design physical environments, they will be involved in designing the interaction technologies embedded within these spaces.

Employ Innovative Funding Strategies for Ongoing Support
An important, if not necessary, prerequisite to these process changes will be changes to funding structures. Long-term systemic changes that improve the quality and flexibility of learning spaces will require investment of financial resources as well as staff effort. The real costs of an effective design process should be factored into budget and fundraising goals. As an example, consider the impact of spending 5 percent of a project’s technology budget in the early stages of the design process to support technology explorations or adding a technology renewal endowment fund to the fundraising efforts associated with a new building. Money alone will not solve design issues, but additional resources coupled with innovative thinking about the design process would be a positive step.

Conclusion
Current design practices will need to change to meet student expectations and support evolving pedagogical approaches. Learning technologies are just
one component of a complex ecosystem in which learning takes place. With the onward advance of technology, materials, and architectural concepts, academic institutions that hope to successfully leverage their facilities and technology assets will evolve their approach to learning space design. They will adopt flexible prototyping methodologies, take steps to modernize funding approaches, and embrace student-centered participatory design practices in the same way that they have student-centered learning pedagogies.

It is important to realize that, especially in the case of learning spaces, design is both a noun and a verb; design outcomes and processes intertwine. New forms of blended learning space will evolve over time as technologies change, people adapt, and new practices emerge. Academic institutions that reconsider how campuses are designed, in both a physical and technological sense, will position themselves to exploit future technologies. Among the most successful institutions will be those that find ways to infuse student ideas into the design process, harnessing the energy and talents of the Net Generation.

Endnotes

1. For a detailed discussion by various authors of student preferences and attitudes, and the implications for academic institutions, see Educating the Net Generation, Diana G. Oblinger and James L. Oblinger, eds. (Boulder, Colo.: EDUCAUSE, 2005), <http://www.educause.edu/LibraryDetailPage/666?ID=PUB7101>.

2. See Beloit College’s Mindset List at <http://www.beloit.edu/~pubaff/mindset/> for more discussion of the world view of students entering college.

3. Communicated in an interview between Dr. John Cowan and the author in February 1990.


10. Ibid. See chapter 2 for a detailed discussion of the design relationship between virtual and physical spaces.


15. For example, state agencies manage fee negotiations for state university projects in Maryland, Idaho, Pennsylvania, and New York.

16. The term “permanently unfinished building” was coined by Larry Friedlander of Stanford University in connection with the Wallenberg Hall facility; see <http://wallenberg.stanford.edu/>.

17. For an example, see EDUCAUSE Learning Initiative (ELI) tools for student photo surveys, <http://www.educause.edu/LibraryDetailPage/666?ID=ELI8001>; available to ELI members only.

About the Author

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DESIGNING FOR COLLABORATION
Technology, Zen and Now
By Craig Park, FSMPS, Assoc. AIA

“No matter where you go, there you are.”

These prescient words, attributed to Confucius over twenty-five hundred years ago, are truer in 2010 than ever before. Over a decade ago, we were adapting buildings for the “Information Age.” Since then, we have seen the “Age of Collaboration” take over. If you haven’t been using, designing, or adapting to collaboration yourself or for your clients, it is time to give collaboration some serious consideration.

As new interactive technologies foster richer collaboration, teaching environments become a microcosm of new collaboration paradigms.

Today, media-rich communications allows us to connect instantly across geographies and time zones in ways Confucius could not envision. Technology has provided both platforms and tools that have dramatically changed how humankind interacts. We take for granted partnerships that were completely impractical just a few years ago, and media-rich collaborations across organizations, institutions and enterprises are now a part of everyday life.

In business, the boardroom is no longer a forum for presentation of past facts, but an interactive 'state-of-the-enterprise' bridge. In institutions, connectivity now spans hierarchies and breaks down bureaucratic silos. In education, the classroom is no longer the limit for faculty or students' possibilities to expand connections to new sources of learning. To succeed in the always-connected world, executives, administrators, students, and teachers are all becoming more agile learners, creators, and collaborators.

ARCHITECTURAL DESIGN CHALLENGES
No longer can planning be left to late in the design process because, while much of technology is still 'buried' in the between the walls, the same technology infrastructure has become as important to the building as its mechanical, electrical and plumbing systems in supporting the architectural design.
There are several key architectural design issues to be considered in a space designated for collaboration. Planning for any collaboration solution requires coordination and integration with facilities (architecture, structural, MEP), as well as AV, acoustics, lighting, IT, and telecommunications infrastructure. Each technology has its own impact on these aspects of the facility, and early analysis can simplify the collaboration system implementation and reduce costs and headaches.

As examples, the following programmatic issues should be addressed early in the planning process:

- **Imaging criteria.** Audience size drives camera location(s), size of screens, and visual sightlines, which in turn have an impact on room width, ceiling height, lighting, audio, and furniture layout flexibility.

- **Furniture selection, component layout, and lighting.** These factors are most often cited as the factors that influence the quality of collaboration systems. Ergonomics are extremely important. This directly relates to the importance of room design. Lighting fixtures should be selected and located to provide good illumination of the participants' faces, and backlighting of the rooms perimeter walls.

- **Room acoustics.** Even more than video, the quality of the audio is consistently rated as most essential by users of any collaboration space. Planning for wall treatments that minimize echoes and control external noise (e.g., HVAC systems) is important.

- **IT Infrastructure.** Internet-based collaboration systems have their planning issues as well. Desktop configurations (i.e., graphics capabilities, memory, hard-drive capacity), LAN capacity and transmission speeds are all issues that should be addressed before implementation.

Rooms designed to integrate video and Internet meeting capabilities require architects to work closely with both the end-users and the AV design team to ensure that room provisioning, proportion and configuration maximize the effectiveness of audio or video collaboration.

The design challenges are twofold. First, it is to help the end user get the best capabilities for their budget, and optimize the functionality of their facilities and the various technology systems. Secondly, and sometimes at cross-purposes to the first, is making the room functional when it is not being used for technology-enabled collaboration. [See Sidebar 1]
TYPES OF COLLABORATION SPACE

Emerging interactive technologies are fostering richer collaboration across all learning organizations, and teaching and teaming environments have become a microcosm of new collaboration paradigms. The new institution is compelled to provide resources from electronically enabled conference rooms and training spaces to desktop media production and on-line learning, from one-to-one communication via smart-phones, to one-to-many multi-casts via video origination systems, to group-to-group using video conferencing systems.

New corporate and institutional facilities demonstrate these innovative technology options with multi-image, tactile and interactive displays, allowing for real time data and analysis to be immersive. New higher education learning spaces mimic the real-world environments of business, research, and development, giving students useful experience in settings simulating those they will find after graduation. On an even more exciting level, new team-oriented collaboration spaces in the growing number of campus learning commons are fostering new entrepreneurial efforts that are a virtual laboratory for new businesses models that will shape the future.

Collaborative projects have become widespread in both the office and in learning environments. Business leaders understand that the best advances in business processes are developed in multi-disciplinary teams. However, collaborators know the challenges of this type of effort. There are similar challenges in academic collaboration efforts, even while the momentum is quickly shifting to self-directed, team-based learning models.

When the entire team contributes (and can see those contributions instantly), the result engenders buy-in and support.

Today, collaborative team-oriented software systems bridge that gap by tracking the progress of each member of the team, allowing each member to see the contributions of the group, reducing duplicated effort. These same systems speed up the collaborative process by increasing interactivity between team members and adding efficiencies to the team’s efforts.
Team collaboration tools also improve inter-team communication, which fosters improvements in reaching goals. Moreover, because the entire team contributes (and can see those contributions instantly), the result reflects the effort of the entire group, which engenders buy in and support.

**CHOOSING THE RIGHT TECHNOLOGY**

Audio, video, and web-based conferencing, as well as collaboration software, continue to improve with advances in technology.

**Audio teleconferencing systems.** These are the easiest to implement, but are not without some of the same design considerations. Even the simple tabletop speakerphone has power cords, transformers, and cables to consider. Building a custom audio teleconference system for a specific conference room requires coordination with both the room and furniture design. It is very important to integrate the microphones and speakers in locations that optimize the voice quality of the system as perceived by the distant participants.

**Videoconference systems.** Video-based systems (often referred to as “Telepresence”) allow for remote communication, presentations and distance learning functions. Newer Internet-based "virtual meeting" systems add even more tools for collaboration by participants anywhere in the world. The technology choices are becoming more robust. As technologies merge with digital networks, the impact on an organization’s telecommunications infrastructure becomes a critical consideration. Each technology system has an impact on the group dynamics and protocols that occur during a meeting. These subtleties are important factors in choosing the right system.

Selecting the right collaboration system for a client is more than just choosing equipment. It takes careful analysis. A technology vision (what are the possibilities) and technology benchmarking (what have other’s done already) help establish a viable program. System options, facilities design, and implementation management are all equally important in ensuring the result will be an easy-to-use and effective tool, and not a complicated and expensive white elephant.

[See Sidebar 2]
THE IMPACT OF COLLABORATION

Regardless of the meeting type, technology can enable effective group collaboration between local, regional, or far-distant participants. The processes of equipment selection, room configuration, procurement, installation, training, content development, and user orientation, requires careful study, planning and logistics management, independent of application or service provider.

All modern organizations—whether business, education, institutional, or governmental—have similar overreaching collaboration issues. They strive to develop strategies that anticipate the impact of the marketplace, competition, or internal processes. Technology is at the center of those strategies. The ability for organizations to collaborate and share vital knowledge benefits all aspects of operations, from communication to distribution to the delivery of key data.

Understanding the potential, options, and logistical issues for a technology-enhanced meeting leads to successful implementations, reduced travel, improved productivity and engagement, and the implicit benefits of cost reductions, and improved quality of life for all of the participants.

TECHNOLOGY-ENABLED COLLABORATION

“I hear and I forget. I see and I remember. I do and I understand.”

For those planning new or renovated collaboration spaces, design issues of ergonomics, lighting, acoustics, audiovisual systems, operational software, information technology, and telecommunications infrastructure to have all become critical to the ultimate success of the project.

In an era when the economies and logistics of travel have become more difficult, multimedia conferencing technology provides an appropriate and cost effective tool for collaboration and information exchange between individuals and groups.

There is little doubt that the demand and application of these systems will increase. As with any effective communication process, early and thorough needs and applications analysis is the key to the successful development of a technology-enabled collaboration facility.
Confucius’ terse advice would be very much at home in the world of Twitter. One virtual tweet from over two millennia ago to consider is “Ability will never catch up with the demand for it.”

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SIDEBAR 1:
COLLABORATION SPACE CHECKLIST
Before any organization makes a significant investment in a particular collaboration solution, there are several important questions to ask:

- Who is participating and what are they trying to communicate?
- What is the best technology and media to transmit the message?
- Does the IT/Telecom infrastructure support the technology?
- How can people use the collaboration system effectively?
- What is the budget?

Key considerations when embarking on a new collaborative technology implementation include:

- Which rooms will be used for collaborative meetings?
- How many sites need to be interconnected?
- How many people at each site will participate in the meeting?
- Are users technophiles or technophobes? (i.e., is the system simple enough for anyone to use?)
- How will they collaborate? (e.g., presentations, distance learning, training, group meeting, etc.)
- What types of supporting media (e.g., paper, or computer-based data like MS PowerPoint®, text or graphics, streaming video, or DVD, etc.) are required?
- Will the meeting be recorded for transcription, documentary use, or archival retrieval/playback?

SIDEBAR 2:
USING THE COLLABORATION SPACE
Probably the biggest factor in successful collaboration environments is user training. After the appropriate collaboration system is defined, selected, procured and installed, there is still the all-important step of orienting the users to best practices in using the facilities. Whether audio, video or web, the structure of the meeting needs to be shared, and the
information exchanged needs to be formatted to best utilize the chosen medium. Technology-based meetings face issues of etiquette and protocol to be successful. Establishing guidelines for speaking order and protocol is important to accomplish before the meeting starts. Software-based presentations (e.g., PowerPoint) and printed documents must be formatted appropriately. There is nothing more frustrating than trying to read text formatted in a ‘too small’ font when trying to grasp critical information.

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MORE
New Directions: New and Enhanced Learning Environments

By Mark S. Valenti and John A. Cook, The Sextant Group, Inc.

Chapter 3: New and Enhanced Learning Environments

Three forces are combining to change the nature of learning environments today and in the future. First, many of the new generation of learners are coming to higher education with habits of mind and spirit nurtured through Web 2.0 environments. Second, the development of ubiquitous, mobile technologies has made every space a learning space. This has forced a rethinking of facilities design and campus master planning. Third, educators are proactively reconsidering learning and collaborative environments and discovering new approaches. Active communities of practice are prototyping new models for learning and research that will foster new relationships between learners, faculty, and mentors. In turn, these new directions are reshaping the design of programs and facilities and the resource allocations necessary to support them.

1. A new generation of learners is coming to higher education with habits of mind and spirit nurtured through Web 2.0 environments.

In the early '90s the onset of both cell phones and the Internet began to change peoples’ expectations of the physical environment. Both technologies were plagued by intermittent performance, clumsy human interfaces, and difficult form factors. A combination of both cost and performance confined these new technologies to the dual realms of business and research, where ROI (or no need for ROI) made early adoption possible. Nevertheless, activities that were once confined to specific places (the office, the lab) began to shift.

In higher education, information was still largely physical in nature and conveyed through traditional means such as books in libraries, lectures in classrooms, and hands-on experiences in labs. Students often studied alone, and instructors were typically viewed as the authority. Other forms of media such as audio and video were just beginning to digitize, but the distribution method was still via physical means – disks and tapes. Distance learning, where available, typically used a broadcast television model (and, indeed, many similar technologies and infrastructures) to deliver education to remote students,
and began the dissolution of the sense of “place” for education. Both systems and operations were complex and required trained operators and technical support.

In the second half of the ’90s the emergence of the web browser, low-cost digital projectors, the affordable laptop computer, and email as a mass communications medium together began to point the way to a new communications paradigm. Further, people were beginning to develop a “computer fluency” that was leading to more sophisticated applications and business opportunities. Web 1.0, as it’s known, was an explosive exploration of new business models, new technologies and services, and new ways to go bankrupt.

In higher education these technologies were adopted rapidly and in wholesale fashion. “Smart classrooms” went from prototype to mainstream in about five years and by 2001 web access in the classroom, while not ubiquitous, was a clearly defined goal for most institutions of higher learning. In many instances, though, the new technology did not alter the traditional teacher-student relationship. Most classrooms were defined by the instructor’s physical location, and most technology simply improved (sometimes) upon existing media, substituting PowerPoint™ for 35mm slides and overhead transparencies. But, the lightning was out of the bottle.

Classrooms occasionally began to connect with each other as Internet-based communication supplanted traditional video links. Students began to connect with each other (and the teacher) as email became a common means of communication. In fact, many instructors, still in a position of “authority,” became overwhelmed by the time management challenge posed by hundreds and hundreds of student emails. Students’ expectations, fed by the essential human hunger for “more, faster,” were increasingly difficult to meet. In many ways, the “Amenities Race” had begun on campuses across the United States.

The “dot.com” crash of 2001-2002 tempered the spending frenzy and brought sense and order back to an information technology market fraught with over-production, vaporware, and dysfunctional technology. As the dust cleared it became evident that a real revolution in technology was underway and Learning 2.0 was about to emerge.

**II. Ubiquitous, smart, mobile devices make every space a learning space.**

The development of affordable, rich media-enabled portable communications devices in the early part of this decade has genuinely begun to change the landscape of learning space. Affordable, powerful laptop computers anchor one end of the spectrum and rich-media enabled wireless devices anchor the other. The Apple iPod is the iconic technology that changed perceptions about the uses to which this class of devices could be turned. Duke University was perhaps first to integrate such technology into its campus technology fabric by issuing free iPods to incoming freshmen in 2004. Since then, the notion of podcasting has become mainstream, and thousands of courses have become digital. Development of resources such as Apple’s iTunes University have enabled learning institutions to offload the management and distribution of course materials.
The commensurate development of wireless Ethernet, 3G communications networks and digital television have resulted in rapid advances in rich media applications and user-friendly tools for content creation and consumption that can be carried anywhere. Activities that were once relegated to the classroom have diffused across campus, with result that many campus buildings have become “fused use” facilities. Libraries, student centers, residence halls, classroom buildings and research facilities exhibit elements of technology-enabled collaboration in both formal and informal space. Essentially, if a student can find a comfortable seat with a network connection and access to food and drink, let the fun - and work, and study – begin! In the early days of Wi-Fi, at least one campus even experimented with wireless network access on the campus loop buses.

These developments together have caused the nature of what occurs during regularly scheduled classes to change and, therefore, users’ (both teacher and student) expectations of the learning space. Students are rapidly changing from consumer to “prosumer,” and faculty are transforming from lecturer to facilitator and even “experience designer.” Now, finally, instructional technologies are combining with a technologically literate user base to support active, engaged learning.

**III. Educators re-consider learning, learning environments and collaborative environments and discover new approaches.**

Paradoxically, these new learning technologies support pedagogical practices that had been known by educators for decades. This is evidenced by renewed interest in Edgar Dale’s “Cone of Experiences” and the increasing use of technology to simulate real-world environments. “Rich media” audio/video systems have been introduced to capture class proceedings, combining video of the instructor with supporting graphics, audio and chat-room information for on-demand viewing either prior to attending class or for later consumption. The web is used to deliver content that was previously the lecture, freeing valuable class time for more active and collaborative learning. The “Smart Rooms” that blanket our campuses, at an annual cost of $5B in North America, began the transformation from classrooms that automate the lecture to learning and collaborative spaces supporting more active and effective learning activities.

The proliferation of robust networks combined with more powerful content creation tools and audio/video capture systems for on-line information delivery enables mass customization for higher education. Further, once the course materials are digital, the incremental cost of course delivery drops significantly, potentially leading to a future where every student has a personal and unique educational experience. This is leading to wholesale course redesign efforts where the course is disassembled and recreated with technology integral to, and not as a layer upon, the course delivery. Course redesign is perhaps best exemplified by the National Center for Academic Transformation and its partner institutions.

Of course, NetGen students, armed with laptops, smart phones and the expectations of on-demand availability, are willing participants. Ubiquitous mobile technologies, typically purchased and supported by the students, are making every space a learning space, creating incredible opportunities and risks for higher ed institutions.
The result is the piloting of innovative spaces on campuses that support lecture, often with two or more simultaneous projected images, but also allow students to gather in small groups and work collaboratively, sharing images and files from laptops, using flat-panel displays as the communal work surface. Collaborative spaces are moving from “found” space (in corridors and stairwells) to planned space, not just small group workrooms, but also into the classroom. These spaces are often referred to as “Studio” or “Black Box” classrooms. Flexibility has become the new buzzword in learning space design. Further, demand for flexibility directly results in demand for more net space per student.

And, as explorations into new kinds of real space are increasing in frequency, interest in virtual space is growing rapidly. On-line virtual environments such as Second Life® offer institutions an entirely new way to deliver courses that scales in ways unrelated to available classroom seats. The New Media Consortium is an excellent example of how institutions are pooling their resources to explore this new world. While currently fraught with difficulties typical of emerging technologies, it seems certain that the economics of such learning environments will prevail as we move into the 21st century’s second decade.

Both of these developments – demand for flexibility and the rise of virtual environments - have serious implications for traditional space planning models and course delivery cost structures. It also argues for a tighter correlation between strategic technology planning and other institutional planning activities.

**IV. This has forced a rethinking of facilities design and campus master planning.**

These new learning environments have a significant impact on campus master planning. The traditional classroom designs and associated formulas simply no longer apply to today’s learning spaces.

- The digital display defines the learning space. What was once a scarce resource due to high cost – either projector or flat panel display - has become the essential resource. Further, additional large screen displays are often desired by faculty and students but challenge traditional architectural models.
- The concepts of “Studio” spaces and “Black Box” classrooms, and collaborative groups within classrooms, require more additional square footage per student.
- Emergent developments in course redesign are demonstrating lower course delivery costs and improved learning outcomes. This argues for a reallocation of capital investment away from large lecture facilities and toward a technology-driven delivery model.
- Virtual environments, in conjunction with serious gaming technologies, are emerging to challenge real space as viable environments for learning.

When technology is used to replace the traditional lecture class time, opportunities emerge to re-think the activities that occur when students and faculty meet face-to-face. Future planning activities must take these developments into account to develop effective strategies for the campus of the future.
Conclusion

The Higher Education community has been fortunate over the years – and uniquely positioned - to dictate to its customers the Space of its choosing according to a Schedule of its choosing in a learning Style of its choosing.

This luxury has started to erode as the tech-savvy NetGen learners, with the expectations of on-demand and personalized learning, will clearly prefer to learn in a Space of their choosing, according to a Schedule of their choosing and in a learning Style of their choosing. They will vote with their tuition dollars for the institutions that fulfill these expectations. The institution that plans for this future will prosper.

Contact

About the Authors

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Resources

The following are resources highlighted in this article.


http://www.unh.edu/pff/seminar/methinstruct/methodref.htm#technology


The Mobile Learner, www.TheMobileLearner.org

The National Center for Academic Transformation, www.thencat.org


By Jordan Weissmann

Online education platform Coursera wants to drag elite education into the 21st century. Now, it's getting buy-in from the academy.

As of yesterday, a year-old startup may well have become the most important experiment yet aimed at remaking higher education for the Internet age.

At the very least, it became the biggest.

A dozen major universities announced that they would begin providing content to Coursera, an innovative platform that makes interactive college classes available to the public free on the web. Next fall, it will offer at least 100 massive open online courses -- otherwise known as MOOCs* -- designed by professors from schools such as Princeton, CalTech, and Duke that will be capable of delivering lessons to more than 100,000 students at a time.

Founded by Stanford computer scientists Daphne Koller and Andrew Ng, Coursera is one of a handful of efforts aimed at using the web's cost savings to bring Ivy League-quality courses to the masses. Its peers include the joint Harvard-MIT project edX and Udacity, a free online university created by
Google executive and former Stanford professor Sebastian Thrun. (Another high-profile startup, Minerva, is attempting to create an actual "online Ivy" that students will pay to attend.)

But the deals Coursera announced Tuesday may well prove to be an inflection point for online education, a sector that has traditionally been dominated by for-profit colleges known mostly for their noxious recruitment practices and poor results. That's because the new partnerships represent an embrace of web-based learning from across the top tier of U.S. universities. And where the elite colleges go, so goes the rest of academia.

Coursera has previously teamed with Stanford, Princeton, University of Pennsylvania, and University of Michigan to offer 43 courses, which according to the New York Times enrolled 680,000 students. It now adds to its roster Duke, Caltech, University of Virginia, Georgia Tech, University of Washington, Rice, Johns Hopkins, University of California San Francisco, University of Illinois Urbana-Champaign, University of Toronto, University of Edinburgh, and Switzerland's École Polytechnique Fédérale de Lausanne.

Only one school, the University of Washington, said it will give credit for its Coursera classes. But two others, University of Pennsylvania and Caltech, said they would invest $3.7 million into the enterprise, bringing the company's venture funding to more than $22 million. Literally, colleges are buying in.

And the bigger the buy-in, the better. The fundamental challenge for U.S. universities as they struggle to contain their costs is figuring out how to teach more students using fewer resources. That's what MOOCs were born to do. In theory, these automated classes have the power to create the first truly radical efficiency gains in the history of higher education, a leap that would take us light years beyond our creaky current system that, as Coursera's Koller noted to me in an interview, is still bound up in traditions that date back to the Middle Ages.

"Lectures came about several hundred years ago when there was one copy of the book, and the only person who had it was the professor," she said. "The only way to convey the content was for the professor to stand at the front of the room and read the book. One would hope that we had better capabilities these days."

We may have the capabilities. But academics are wary of them. In a recent poll by Inside Higher Ed and Babson Survey Research Group, 58 percent of professors said they were more afraid of online learning than excited by it. A full two thirds percent said learning outcomes on the web were inferior to in-person instruction. Yet, the more experience instructors had teaching online, the more positive they felt about it.

And therein lies Coursera's promise. The company does not consider itself an alternative to a traditional university. Rather, it's more of a market for learning. Schools that design classes for Coursera retain the rights to their work, meaning it's a risk-free way for them to dip into online education without building the technology infrastructure from scratch. In turn, professors can incorporate the web material into their regular courses, for instance by turning their 9 a.m. lectures into homework. In time, the process could breed more familiarity, less contempt, and much more efficient classrooms.

As Koller and Ng acknowledged in our interview, Coursera is still in some ways a work in progress. Its grading technology, they said, is capable of assessing sophisticated assignments in science and math, but the company is still working out the best way to handle longer written work for humanities and social science programs. And as with many Silicon Valley darlings, how it will generate revenue is also a bit of an open question. Ng suggested that some schools may sell branded certificates, or that Coursera could begin offering career placement services, matching employers with students who demonstrate specific skills.
I asked Ng if he felt that would risk turning Coursera into a competitor with the traditional universities that provide its courses. His answer, in short, was no. The real value of attending an elite school, such as Caltech, he said, is not the content of the courses. Rather, it's time spent working directly with professors and other students. And by letting schools put lectures online, Coursera has the potential to make more time for those interactions.

"With this technology, we're improving education for the hundreds of thousands of students out there, as well as improving it for the students on these campuses," Ng said.

That's an answer about Caltech or Princeton. What it leaves unaddressed is whether some day, students might choose to take inexpensive Coursera classes instead of attending a pricier mid-tier college. It's premature to speculate about that. But regardless of whether you believe that today's brick and mortar universities will still be our main vehicles for higher education in long term future, yesterday's announcement gives you something to celebrate -- because while Coursera isn't looking to end college as we know it, it is trying to nudge it into the 21st century.

And colleges themselves seem to be on board.

*Not to be confused with the delightful epithet "mook," in case you're a Scorsese fan.

This article available online at:

http://www.theatlantic.com/business/archive/2012/07/the-single-most-important-experiment-in-higher-education/259953/

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CONCLUSION

Worldwide, networked learning will replace place-bound teaching. — Michael Dolence
Transforming Higher Education: A Vision for Learning in the 21st Century

Summary
The advent of personalized, collaborative, self-directed, and globally connected learning has ushered in significant changes in the pedagogy at public and private institutions of higher learning. This, in turn, is causing a fundamental flip in the way students are taught and how they learn. As a result, space needs and class formats are changing to adapt to student expectations for learning anytime, anywhere, on their terms.

Campuses are shifting to new and exciting learning space models that provide real opportunities for architectural design innovation. The Sextant Group’s Technology Visioning workshops explore emerging pedagogies and enabling technologies and the related planning, design, and infrastructure issues that the campus and their architects face in designing contemporary buildings for education.

At the end of a Technology Visioning workshop, participants will be able to:

- Understand how student demographics and new pedagogies are changing expectations for higher education facilities.
- Understand how emerging technologies are affecting the design of educational facilities of the future.
- Adapt architectural and interior design to meet these pedagogical changes.
- Understand how emerging technologies are affecting the programming of architecture for higher education.

Thank you for taking the time to review this material. We have provided links to additional resources on the following page.
OTHER RECOMMENDED RESOURCES

✦ EDUCAUSE
  o http://www.educause.edu

✦ International Society for Technology in Education (ISTE)
  o http://www.iste.org

✦ National Center for Academic Transformation (NCAT)
  o http://www.thencat.org

✦ NPR: “Don’t Lecture Me”
  o http://americanradioworks.publicradio.org/features/tomorrows-college/lectures/

✦ Sir Ken Robinson: “Changing Education Paradigms”
  o http://www.youtube.com/watch?v=zDZFcDGpL4U

  o http://www.theatlantic.com/business/archive/2012/05/the-big-idea-that-can-revolutionize-highereducation-mooc/256926/

✦ NPR: Diane Rehm Show “Universities Shift to Online Learning”
  o http://thedianerehmshow.org/shows/2012-07-31/universities-shift-online-learning

✦ Time Magazine: Salman Khan: The New Andrew Carnegie?
ABOUT THE Sextant Group

The Sextant Group supports owners and architects across North America with demonstrated expertise in Strategic Technology Planning, Planning and Programming, Infrastructure Design, Systems Design & Specification, and Construction Administration for new construction, facility renovation and the realization of intelligent buildings. While much of our work focuses on clients in Higher Education, we have significant and relevant experience in Corporate, Healthcare, Sports, Museums, and other technology-enhanced project types. Our services include:


✦ ARCHITECTURAL LIGHTING: Architectural Lighting Design (both interior and exterior) for Exhibits, Galleries, Displays, Hospitality, Retail, Restaurants, plus theatres, sound stages, television studios, video teleconference rooms, other spaces involving audience and/or cameras

✦ INTELLIGENT BUILDING SYSTEMS: Building Automation Systems, Smart Buildings, Building System Controls, Building Management Systems

✦ FACULTY SUPPORT & DEVELOPMENT: Pedagogical Visioning Workshops; Online Surveys; Faculty Support Seminars; “Pilot” Learning Spaces Development; Participants’ Progress Monitoring; Formative Assessments; Follow-up Support, Mentoring, and Coaching; Final Assessments

The Sextant Group’s staff includes more than 50 industry-certified designers for audiovisual systems (CTS, CTS-D), information technology experts (RCDD), professional engineers (PE), lighting designers (LC), and USGBC LEED® accredited professionals. We are fully integrated with a nationwide technology network, including the ability to work seamlessly in the 3D (Revit™) BIM models, allowing us to work effectively on projects anywhere in the US or in the world.