Chapter 11. Designing Blended Learning Space to the Student Experience

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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.[1] 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.[2] 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."[3] 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.[4]
- **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.[5] 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.[6] 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.[7]
- **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.[8] 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

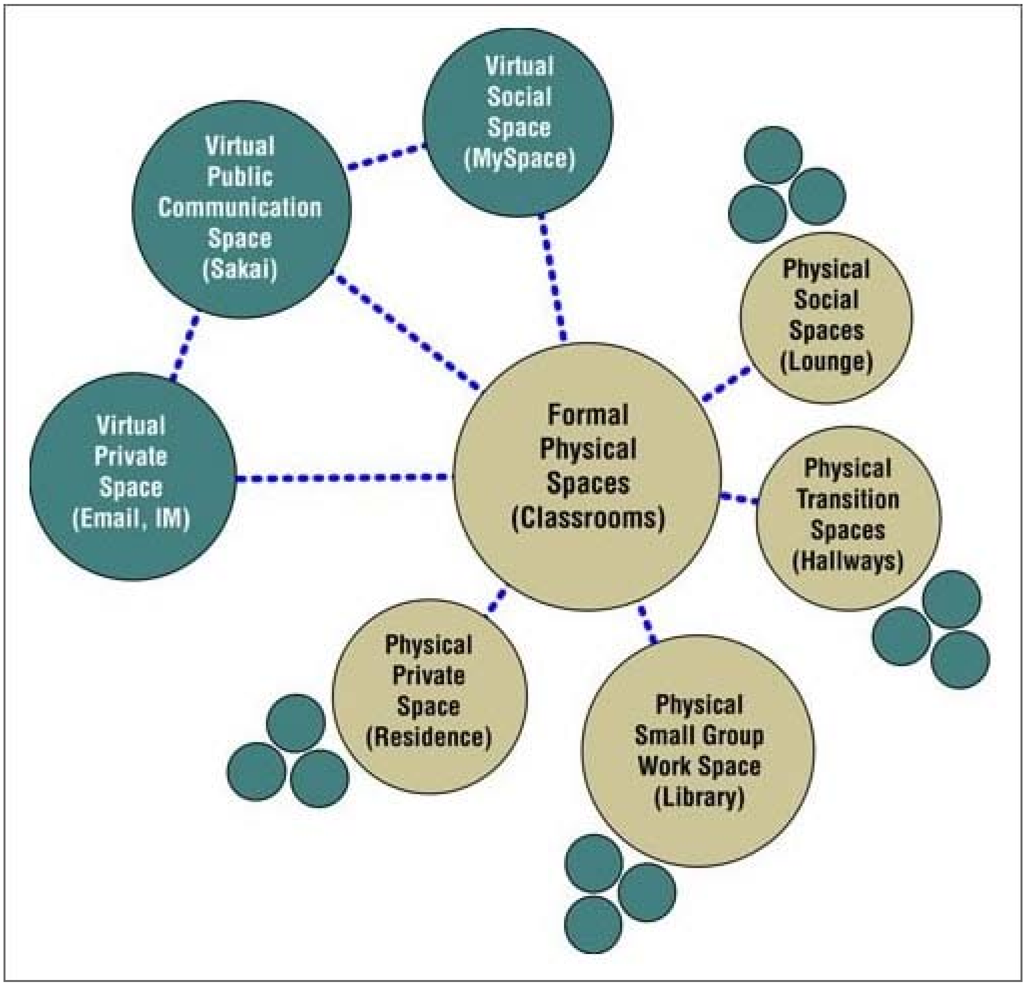
- **Personal information and communication devices.** Mobile technologies such as laptops, cell phones, PDAs, Tablet PCs, iPods, digital cameras, Wi-Fi finders, USB drives, and GPS systems are part of our personal communication culture.

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.[9] 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.[10]

Figure 1. The Varied Nature of Blended Learning Environments



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 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 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"[11] 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.[12] If not built into the initial project, it will draw resources from other line items if added later. Once a building is online, campus or department IT organizations manage these components, and the systems' upkeep becomes that group's responsibility. A variety of models for ongoing support of these systems exist, including per-port service fees to departments or accommodation as part of the overall IT budget.

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.[13] 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.[14] 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,[15] 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.

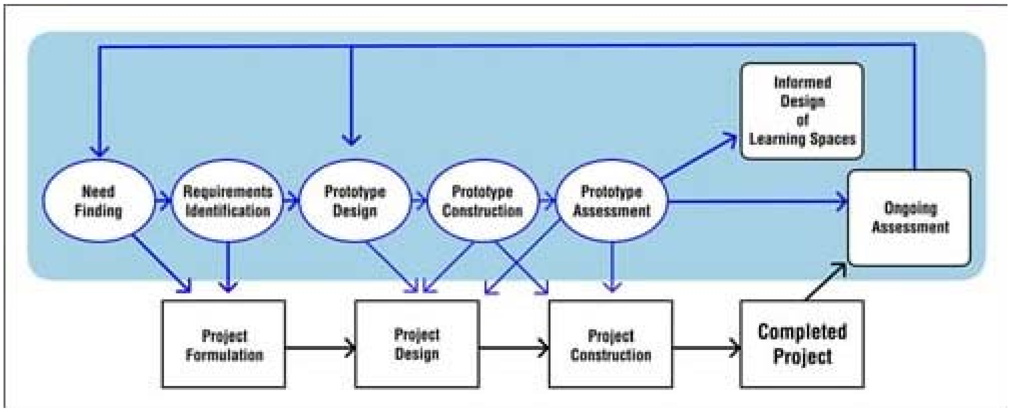
Ethnographic-style observational studies, although a desirable approach, can be time-consuming and costly. Alternative techniques that leverage student involvement include student photo surveys coupled with journal entries[17] or multimedia blogging that encourages students to discuss their daily activities 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



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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.
4. See slide #28 in the presentation "Process for Designing Learning Spaces" by Ed Crawley and Steve Imrich at the 2004 NLII Fall Focus Session, Cambridge, Massachusetts, September 10, 2004; available at <http://www.educause.edu/LibraryDetailPage/666?ID=NLI0442>.
5. Diana G. Oblinger, "Is It Age or IT: First Steps Toward Understanding the Net Generation," in *Educating the Net Generation*, Diana G. Oblinger and James L. Oblinger, eds. (Boulder, Colo.: EDUCAUSE, 2005), <http://www.educause.edu/LibraryDetailPage/666?ID=PUB7101>.
6. Gregory Roberts, "Technology and Learning Expectations of the Net Generation," in *Educating the Net Generation*, Diana G. Oblinger and James L. Oblinger, eds. (Boulder, Colo.: EDUCAUSE, 2005), <http://www.educause.edu/LibraryDetailPage/666?ID=PUB7101>.
7. See Marc Prensky, "Digital Natives, Digital Immigrants, Part 1," *On the Horizon*, vol. 9, no. 5 (October 2001); available from <http://www.marcprensky.com/writing/>.
8. Amanda Lenhart and Mary Madden, *Teen Content Creators and Consumers* (Washington, D.C.: Pew Internet & American Life Project, 2005), <http://www.pewinternet.org/pdfs/PIP_Teens_Content_Creation.pdf>.
9. Andrew J. Milne, "An Information-Theoretic Approach to the Study of Ubiquitous Computing Workspaces Supporting Geographically Distributed Engineering Design Teams as Group-Users," PhD dissertation (Palo Alto, Calif.: Stanford University, Department of Mechanical Engineering, 2005), pp. 28–34, < http://www-cdr.stanford.edu/~amilne/Publish/AJM-thesis-SUBMITTED_17mar05.pdf>.
10. Ibid. See chapter 2 for a detailed discussion of the design relationship between virtual and physical spaces.
11. Mark Valenti, "The Black Box Theater and AV/IT Convergence: Creating the Classroom of the Future," *EDUCAUSE Review,* vol. 37, no. 5 (September/October 2002), pp. 52–62, <http://www.educause.edu/LibraryDetailPage/666?ID=ERM0254>.
12. Communicated in a meeting between Michael Leiboff and the author in January 2006.
13. Steve Harrison and Paul Douris, "Re-Placing Space: The Roles of Place and Space in Collaborative Systems," in conference proceedings for the ACM Conference on Computer Supported Cooperative Work (CSCW–96), Cambridge, Massachusetts, 1996, pp. 67–76.
14. Standard process phases for building design and construction services are discussed in chapters 17 and 18 of *The Architects Handbook of Professional Practice*, American Institute of Architects (New York: John Wiley & Sons, 2001).
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?IE=ELI8001>; available to ELI members only.
18. For a discussion and example of workspace "instrumention," see Andrew J. Milne and Terry Winograd, "The iLoft Project: A Technologically Advanced Collaborative Design Workspace as Research Instrument," Proceedings of the International Conference on Engineering Design (ICED'03), Stockholm, Sweden, 2003. For the paper see < http://www-cdr.stanford.edu/~amilne/Publish/ICED03_iLoft_Paper.PDF> and for the slides <http://www-cdr.stanford.edu/~amilne/Publish/ICED03-Pres-Milne.pdf>.

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