Learning Spaces

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CHAPTER 9

Trends in Learning Space Design

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This chapter examines significant trends in learning space design, both in new construction and in renovation, and relates them to learning theory and technological advances. Three major trends inform current learning space design:

- Design based on learning principles, resulting in intentional support for social and active learning strategies.
- An emphasis on human-centered design.
- Increasing ownership of diverse devices that enrich learning.

These trends have been catalyzed by constructivism, digital technology, and a holistic view of learning.

The emergence of the constructivist learning paradigm has led to a focus on learning rather than teaching. It allows us to reevaluate classrooms and to consider informal learning spaces as loci for learning. If learning is not confined to scheduled classroom spaces and times, the whole campus—anywhere and at any time—is potentially an effective learning space. That holistic view of learning presents challenges, however. First, the demands on student time and attention continue to grow; even residential institutions have over-scheduled students. Second, learning doesn't just happen in classrooms; learning also occurs outside the lecture hall. New strategies for enabling learning and accommodating the multiple demands on student time have led to rethinking the use, design, and location of learning spaces.

The emphasis on learning means that we must also think about the learner. Learning spaces are not mere containers for a few, approved activities; instead, they provide *environments for people*. Factors such as the availability of food and drink, comfortable chairs, and furniture that supports a variety of learning activities are emerging as critical in the design of learning spaces—evidence of the second trend, giving consideration to human factors as integral to learning space design.

The rapidly increasing accessibility of digital technology also has changed learning space design. Digital technology continues to advance at a frenetic pace, offering greater capability while simultaneously becoming more mobile and more affordable. Five years ago, most students purchased desktop computers; two years later, most purchased laptops. The implications are significant: more affordable and mobile technology facilitates greater access to content and resources. This enhanced access, in turn, has made it possible to implement a learning paradigm that emphasizes active learning, formative assessment, social engagement, mobility, and multiple paths through content. Although specific technologies may come and go, the enduring trend is technology becoming more capable, affordable, and mobile.

Trend 1: Active and Social Learning Strategies

Today, facilities that encourage learner participation are increasingly important in learning space design. Active learning, interaction, and social engagement will be significant in the future.

Review of Learning Principles

Over the past two decades, a great deal of research has focused on how people learn. Previously, teaching was most often a kind of "broadcast" of course content at regularly scheduled intervals, from an expert to student "receivers." The learning literature agrees that learning can be enhanced, deepened, and made more meaningful if the curriculum makes the learners active participants through interactivity, multiple roles (such as listener, critic, mentor, presenter), and social engagement (such as group work, discussion boards, wikis). Hence, it is no surprise that learning spaces—classrooms as well as informal spaces—have an increasingly important role in catalyzing this type of learning.

Learning Space Design Genealogy

The unrelenting pace of technology change can make IT decisions rapidly obsolete. While platforms and applications come and go, the psychology of how people learn does not. Constructivist learning principles, specifically activities identified as encouraging learning, can be translated into design principles that guide tactical decisions, ensuring that the designs we build and the technology we deploy serve a clear educational purpose. This suggests a design methodology with a clear "genealogy" having constructivist principles as the "parent" of design principles leading to specific tactics that support and enhance learning.

Social interactions such as debate, discussion, and teamwork, for example, encourage learning, prompting a design requirement for rooms that can be reconfigured quickly for small discussion groups. If accepted, this principle leads to decisions such as selecting lightweight, wheeled chairs that permit easy reconfiguration of the room's seating.

Or, consider *metacognition*—the learner's active assessment of his or her own learning. Such a learning principle might lead to the creation of explicit points or locations that will encourage and enable this self-assessment with the instructor's assistance. Locating faculty offices in the learning commons might facilitate this, giving students ready access to mentors for guidance and assessment.

Active and Social Engagement

The traditional layout of auditoria and lecture halls has rarely provided for social engagement among students. No doubt we all have many classrooms whose floor plans look essentially the same. This arrangement is not conducive to discussion among students; the design optimizes instructor transmission. In the traditional classroom floor plan, students receive content, packaged and presented with a "one size fits all" approach, regardless of the learners' unique needs or styles.

There is an increased emphasis on alternatives to a simple transmission model of pedagogy. Personal response systems, videoconferencing capabilities, floor plans that foster face-to-face contact among students, technology that supports the sharing of computer screens, and virtual whiteboards indicate a shift in learning spaces to support how people learn.

Many signs herald a move toward active and social learning spaces. Interest in informal learning spaces stems from the realization that informal spaces are particularly conducive to working spontaneously and deliberately in small or medium-sized groups. "Rethinking" informal space is characterized by coordinating architecture and technology to create powerful learning environments based on floor plans, furniture, and technology. This rethinking embraces services and products such as wireless networks and plasma screens supported by partnerships among units, such as the library and IT.

Trend 2: Human-Centered Design

The trend toward human-centered design is embodied in the shift from the *information commons* to the *learning commons*. The term "commons" means "land or resources belonging to or affecting the whole of a community," according to the *Oxford American Dictionary*, which seems particularly pertinent to the trend of human-centered approaches in learning space design. The notion of the commons is evolving, with an increasing emphasis on users and the range of services learners require; the learning commons illustrates human-centered design.

A quick glance at past practice helps us appreciate the significance of current directions. Through the 1990s, accessing digital resources was a challenge, requiring the use of a computer beyond the financial reach of many students; a minority of students owned laptops. The challenge for most institutions was simply giving students access to computers to do their work. The cost of computers and scarcity of space meant providing clusters of computers in specified areas for student access, echoing the design of transmission-style classrooms. This approach implicitly assumed that access, by itself, was sufficient. With access established and basic operational questions resolved, the students and faculty presumably were empowered to accomplish their academic tasks. Students in particular were assumed—then as now—to know everything about computers. Moreover, the assistance provided was scattered across multiple offices and delivery points, which might have served the support units but not the students and faculty.

Today, given the increasing proliferation of information technology, the need for basic access is not as acute as a decade ago, allowing the focus to shift from the provision of basic access to that of integrated services to aid learning. This shift has given us the leeway to evolve our notion of what the commons is and does. Increasingly, the commons is a locus of integrated support services, including assistance for research, computing, writing, media preparation and production, academic skills, and English-as-a-second-language training. Now explicitly designed into the commons are spaces for both individual and group work. In some cases colocated offices for faculty encourage more direct work with student teams. Food and drink have made a significant comeback—an important factor in humanizing the space.

The learning commons is human-centered. The term *learning* signals a significant change: the focus is not just finding information but applying that information in productive ways to deepen and strengthen learning as well as to construct knowledge. Learning, not information, is increasingly the focus. The move away from transmission to constructivist learning and developments in technology has enabled this redefinition of the commons. If the constructivist model reflects how people learn, a more human-centered design of learning space is a positive change. (See Table 1.)

Table 1. Repositioning the Commons

Previously	Currently
Information downloaded	Information created, integrated
Individual workstations	Social work setting
Isolated support delivery	Integrated support
Students only	Faculty too
7 × 12 access	7 × 20 access
"No talking!"	Whiteboards abound
No food	Cybercafé

The increasing integration of computing technology into the mainstream of daily activity enables this transition. One size may be *adequate* for all, but it's not particularly good for any given learning activity. Learning spaces in the 21st century need to foster discovery, innovation, and scholarship, not simply contain them.

Building spaces for learning has always involved collaboration among a variety of campus groups, including students and departmental faculty. As the emphasis on supporting learning activities rises, more ownership shifts to faculty and students. They are assisted, rather than led, by architects, builders, and facilities professionals. Learning environments should be developed by those who will use them.[1] Faculty and students are the product experts, while the architect is the space development expert. Shifting the focus to users of the space links the process to the human-centered design outcome. It also emphasizes learning activities rather than resources as the driving factor: people and learning, not managing capital goods, must take precedence.

The critical difference in the design processes lies in:

- Creation of a systems design requirements document with input from a wide variety of faculty, students, teaching and learning professional staff, facilities staff, and security and maintenance professionals.

- Formation of an integrated product team whose job it is to respond in real time during construction to issues, questions, or problems that inevitably arise so that the resulting learning space carries through with the intention of the requirements document.

Systems Design Requirements

An initial prerequisite to building a space that increases learning effectiveness is understanding what kinds of teaching and learning activities the space should enable. This entails identifying the demands for curriculum, learning, laboratory, and workshop activities that the space must meet.

With a clear definition of the learning goals, space design becomes grounded. Critically important is identification of the clients who will use the space, a process made easier when the space is designed for a specific department's needs. When the college or university claims the space, an analysis of the pattern of use of becomes essential. In many cases a small number of departments habitually use the same classrooms simply because of common seating requirements for their courses, without regard to the amenities or technology available in the rooms. Building classroom spaces without a defined client base results in a design that meets no one's needs optimally.

Learning Activity Analysis

Determining what activities the space must support is perhaps key to distinguishing a well-designed learning space from a room in which activity happens. Learning mode analysis (LMA) characterizes learning activities in terms that affect space design. For example, prior to engaging in the renovation of MIT's Guggenheim Laboratory, home of the Department of Aeronautics and Astronautics, university representatives articulated learning activities considered critical for students to master.[2] Knowing what students should learn permits defining the learning activities necessary to achieve mastery of critical subjects; this generates an LMA description. Once the activities and their consequences for space design are known and prioritized, architects can design spaces for these activities.

Integrated Product Team

Inevitably in any construction project, discrepancies emerge between the ideal and the reality. A process for responding to this gap is a normal part of the construction process. Learning-centered design differs in that the group responsible for addressing these gaps includes the original clients—faculty and students. The trend toward a more human-centered design requires that the people who teach and learn in the built space remain engaged throughout the process, ensuring that effective teaching and learning remains the focus.

Trend 3: Devices That Enrich Learning

The pace of technology change makes it increasingly difficult for colleges and universities to provide a robust, contemporary technology infrastructure. Students are entering college with a variety of personal technologies, from MP3 players to computers. With the burden to provide access to technology shifted, technology to support learning moves into focus.

Colleges and universities have the opportunity to redirect resources previously dedicated to computer labs to leverage the technology students bring to campus. This requires a focus on software implementation and interoperability rather than buying and deploying standard technology. The shift represents a significant change, but the resources that students carry with them are potentially powerful academic tools whose capabilities go well beyond their value for recreation and entertainment.

Podcasting

With the explosion of MP3 players, a tool for distributing audio content already is in student backpacks. Duke University's iPod experiment[3] provides an example of how a consumer music player can provide portable digital audio and other types of content (iPods function as a portable hard disk as well). Duke identified five major use categories:

- **Course content dissemination:** dissemination of prepared audio content such as lectures, songs, historical speeches, and foreign language content
- **Classroom recording:** personal lecture/discussion capture
- **Field recording:** field notes, interviews, and so on
- **Study support:** replaying audio content, whatever the source, for studying
- **File storage and transfer:** simple file transfer and backup, especially for media files.

Institutions participating in these types of experiments have found a close connection between the distribution infrastructure for audio content and the user experience. iTunes and the iTunes Music Store (iTMS) make distribution of music or any other type of content simple. iTMS is, after all, just another digital repository "tuned" for music, podcasts, and now video.

Software Deployment

As students arrive on campus with laptops or other computing devices, they will need applications to support their coursework. Resources once spent buying hardware are being redirected to applications. Software deployment options range from an application server environment that works with many different client computers to building installer packages to load institutionally licensed applications on student-owned machines.

Tools such as Citrix Presentation Server (http://www.citrix.com/) virtualize the delivery of Windows and Linux applications.[4] Only the student's PC needs to run the virtualization client that connects to the presentation server on which the application runs.

Most institutions have already deployed software for students to install on their personal machines. Unfortunately, the technology for installation is not matched by the business models of software vendors who presume a one–to-one relationship between a software purchase and the student's machine. Custom delivery of software requires more flexible and effective licensing models.

Thumb Drive Virtual Environments

As the capacity of USB flash memory drives (UFDs) increases (up to 8 gigabytes at the time of this writing),[5] these raw data storage devices can also serve as self-contained portable application environments. While campuses would still provide keyboards and screens, UFDs could be connected to a basic PC. Students would carry their digital computing environments on their UFDs, equipped with bootable operating systems, a suite of applications, security tools, and even a biometric identification feature so that a lost UFD could not be accessed easily by someone other than its owner.

Companies like U3 or NCD Systems assemble applications on UFDs and also provide build-your-own developer kits. Moving from an enterprise-central infrastructure to personal silicon may cause us to reconsider the economics, scalability, and functions that support student learning.

Cell Phones

Device convergence rouses speculation about the future of cell phones, PDAs, MP3 players, and computers. Using cell phones to better support teaching and learning has largely focused on extending the short message service (SMS) communications function to support interactive personal response services (PRS). Students in Japan use cell-phone messaging to take quizzes in class. Student book purchases, now enabled by Internet textbook stores, are automated in redesigned self-service bookstores through the e-wallet cell phone (Sony's FeliCa Contactless IC technology combined with NTT DoCoMo's Internet services iMode; see <http://www.nttdocomo.com/services>).

Controlling Lab Experiments from a Browser

The Internet promises to extend student access to resources that are in short supply, expensive, dangerous, or otherwise inaccessible to them. Browsers have made astronomy observatories, scanning probe microscopes, and scanning electron microscopes available to researchers around the world.[6] These applications are moving individual, unique implementations to a services-based architecture, grounded in Web standards that will allow access by large numbers of students.

Both technical and economic challenges affect access to scientific devices. The technical issues revolve around establishing a common infrastructure for a range of experiment types using Web services. The economic challenge entails developing a mechanism that allows faculty to share experimental devices without taking on the extra work associated with additional users. A priority scheduling system ensures that researchers' needs are served while sharing extra capacity with students.

A scalable software architecture for offering real experiments to students opens otherwise inaccessible opportunities to distance learners. On residential campuses, experiments brought into the classroom can give students more control over their "lab work."

Conclusion

With the right approach, the entire campus can become a learning space.[7] The three trends highlighted in this chapter underlie this emerging reality: design based on learning principles, human-centered design, and personal devices that enrich learning.

Our growing understanding of how people learn affects the configuration of learning spaces and the technologies supporting them. The constructivist paradigm supplants knowledge transmission as the guide for learning spaces, encouraging more thoughtful space planning. It also necessitates a proactive process to ensure that these learning spaces deliver value.

Human-centered design helps us keep people—not the latest technology—in the forefront of design decisions. With access no longer driving technology deployments, a focus on the "why" rather than the "how" of learning space design becomes possible. You can't build effective spaces for learning without clearly understanding the learning activities intended for them.

Our focus on enabling learning spaces has also shifted to a much more personal view. The technologies that students bring to campus are eclipsing the technologies colleges and universities can supply, broadening our concept of learning spaces to anywhere, anytime learning on residential, commuter, or virtual campuses. The shift from teaching to learning pervades the future design of learning spaces, with learning theory guiding technology implementation.

Further Reading

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Endnotes

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3. Yvonne Belanger, "Duke University iPod First Year Experience Final Evaluation Report," June 2005, <http://cit.duke.edu/pdf/ipod_initiative_04_05.pdf>.
4. Other software providing application virtualization includes Softricity, <http://www.softricity.com/products/index.asp>; Trigence, <http://www.trigence.com/>; and Meiosys, acquired by IBM as announced by an IBM press release, <http://www-03.ibm.com/press/us/en/pressrelease/7755.wss>.

5. Described in an M-Systems press release, “M-Systems Celebrates Five Years of DiskOnKey USB Flash Drives with the Introduction of a New Whopping 8 Gigabyte Density,” <http://www.m-sys.com/site/en-US/Corporate/PressRoom/PressReleases/2006/NR060104-3.htm>; and Edward Mendelson, “The Ultimate USB Key,” *PC Magazine* (August 17, 2005), <http://www.pcmag.com/article2/0,1895,1849710,00.asp>.
6. See the Internet2 Web site, Remote Instrumentation, <http://science.internet2.edu/remote.html>; Electron Microprobe Laboratory, University of Minnesota–Twin Cities, Department of Geology and Geophysics, Remote Access, <http://probelab.geo.umn.edu/remote.html>; and the Web site for California State University Channel Islands (CSUCI), Academic Programs, Virtual Instrumentation Access at CSUCI (VIA-CI), <http://viaci.csuci.edu/>.
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About the Authors

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