EDUCAUSE | LEARNING INITIATIVE

Learning Environments:

Where Space, Technology, and Culture Converge

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If we traveled back in time to a college classroom of, say, 1900, what would we see? A professor standing at the front of the room lecturing. Students sitting in desks in rows, taking notes on paper. Some interaction between the students and the professor—probably not so much between students. We would see books, pencils, a chalkboard and erasers.

There wouldn't be laptops, projectors, iPhones. No one would be surfing the web or sending instant messages to people in another classroom across campus or on the other side of the world. Looking at any college campus today, we would see these and other changes, many of which are the products of developments in technology and some that are not. In higher education today, students and faculty carry always connected electronic devices. The amount of information available from those devices dwarfs what was formerly available in any university library. Some classes meet in rooms with desks and a professor who lectures, but students today also have access to learning resources in a coffee shop, at the rec center, sitting under a tree. The introduction of information technology into virtually every aspect of our lives has led educators and students to think differently about where and how learning takes place. Technology has opened vast numbers of new doors into learning; it has also helped us better understand facets of learning that have nothing to do with technology. It is the catalyst that compels us to look at what's new, what isn't new, and to try to understand how all of the factors work together.

What would we see, then, if we traveled forward in time? As we develop an understanding of the many elements that influence learning and work to arrange those elements in ways that improve learning, what does teaching and learning look like? Where and how does learning take place? Who is involved?

When the EDUCAUSE Learning Initiative sought input from members of the higher education IT community about issues they see as most challenging, the topic that generated the largest response was creating learning environments that promote active learning, critical thinking, collaborative learning, and knowledge creation. There is a strong and growing desire to try to make sense of the remarkable changes that colleges and universities have undergone in the past generation and to understand IT in the wide framework of educational opportunities. Technology has precipitated a discussion that ultimately goes beyond technology, one that seeks to understand what institutions of higher education and the people in them can do to create the circumstances for effective learning.

Legacy of Learning Spaces

As long as teachers have taught and students have learned, people have thought about learning spaces. Where do people go to learn? What do those places look like? How does the arrangement of a learning space contribute to—or detract from—the task of education? In ancient times instruction was often conducted in public places or in natural or sacred settings where students clustered around a teacher. The medieval European university echoed these practices, drawing students to centers of learning largely on the renown of the instructors—indeed, the medieval university existed primarily for the sake of faculty and their collaborative research. The lecture halls, seminar rooms, teaching galleries, studios, and faculty offices familiar today derive from these institutions, and for much of modern history, the dominant model for a learning space has reflected this structure—a classroom in which the instructor occupies a position of focus in a room and students are arranged as an audience. For certain kinds of teaching and learning, this was and remains an appropriate design.

The age of information technology introduced a new lens for examining learning spaces and the model on which they are built. The addition of computers, projectors, networks, and electronic media

to classrooms, laboratories, and studios brought about transformations in the physical spaces devoted to instruction. Distance learning prompted a further reexamination of the classroom-based learning paradigm in an effort to understand what characteristics promote effective education, how they can be translated into technology-mediated learning, which of them are intrinsic to physical spaces, and which might be separable from actual places and particular moments in time.

When new technologies emerge, they are initially understood and often first applied in familiar ways and by means of familiar metaphors. Early printed volumes appeared in fonts that resembled those of manuscripts, for instance, so as to borrow the status and perceived value of the then-traditional form. Even as information technology added new layers to the educational enterprise, the archetype of the classroom continued to serve as a compelling organizing concept in online and computer-mediated learning. Web-based conferencing software tools typically use the model of rooms, even to the point of having common and break-out spaces. This terminology has the benefit of being well understood, translating the organizational habits we know from physical spaces to virtual ones. Many asynchronous settings also make use of space-derived structures, and learning management systems typically compartmentalize learning resources into courses and sections, creating online classrooms that reflect traditional physical learning spaces.

When these systems were new, this design approach seemed natural because the template was inherited from classroom-based courses, but that approach came under growing scrutiny as educators began to take a critical look at different models of teaching. New conceptions of learning spaces were fundamental steps in that inquiry, and new possibilities of instructional technology demonstrated that digital versions of traditional classrooms were unnecessarily limiting in many situations. It became clear that access to information or the chance to participate in a learning forum should not be limited by a design of learning spaces that focused on students in specific courses, learning in highly circumscribed places. Deep and broad discussions about learning space design have challenged assumptions, provided new ideas, and generated evidence of the benefits of differently conceived learning spaces, both physical and virtual.

Those conversations have been extremely valuable, and they serve as the foundation for an expanded look at other factors that affect learning and the context in which learning spaces exist. Those factors include space, of course, but a broader look at the conditions and circumstances of learning reveals that learning is equally influenced by people, by technology and the resources it affords access to, and by the cultural backdrop against which learning takes place. These elements come together in a new, broader discussion of learning environments, which builds on the resources and knowledge generated about learning spaces.

The learning space remains the heart of the educational enterprise, but the time has come for educators to widen the scope of inquiry about effectiveness in learning to include a fuller list of factors. The term *learning environment* encompasses learning resources and technology, means of teaching, modes of learning, and connections to societal and global contexts. The term also includes human behavioral and cultural dimensions, including the vital role of emotion in learning, and it requires us to examine and sometimes rethink the roles of teachers and students because the ways in which they make use of spaces and bring wider societal influences into play animates the educational enterprise. The focus on information technology in education is expanding from the enhancement of learning spaces to include factors beyond hardware, software, and the network. The learning environment is a composite of human practices and material systems, much as an ecology is the combination of living things and the physical environment.

Purpose of this Paper

The intersection of several trends makes now the right time to move beyond the discussion of learning spaces and begin to think about learning environments. As valuable as discussions of learning space design have been, the time has come to build the context around spaces and investigate the broader concept of environments. Public expectations are changing. The economics of higher education are a concern, as are its implications for access and the ability to meet the needs of the workplace. The growing influence of technology in the learning environment only sharpens the debate: Are traditional educational goals and models still appropriate, or is the knowledge required for success in today's workplace and global economy fundamentally different? Education needs a fresh focus on what constitutes effectiveness and efficiency in learning.

Many students enrolled in colleges today harbor different expectations from those of only a generation ago about the kinds of learning activities they will experience. The role of higher education within society has expanded and changed, and the student population has become tremendously more diverse. The traditional full-time residential college experience immediately following high school graduation is becoming less dominant. At the same time, employers increasingly look for individuals who can function effectively in a workplace that depends on collaborative work, integrative learning, and creative problem-solving. The imperative for authentic learning is well understood. To the extent that educators and institutions recognize the range of factors in a learning environment, they will be better prepared to develop educational programs that replicate the conditions in which students will one day work. Many professional programs—business, law, and engineering, for example—have adjusted their curricula over the years to model the kinds of activities and circumstances that graduates are likely to experience when they enter the workplace.

The cost of higher education is rising, and expenses related to technology in education represent a non-trivial portion of that cost. Resources are always limited, but in the current economic climate, budget pressures on higher education have in many cases become extreme. Investments in the tools and facilities of education—and in the personnel to operate and support them—must be made very carefully, and part of knowing where money is best spent is understanding the system of factors—the environment—that can improve student success.

Higher education is extending its reach so as not to rely solely on a place-based model of education, in part because students, many of whom work to pay for schooling, increasingly demand access to educational resources from more times and places and in part because technology makes possible modes of learning that would have been impossible just a few years ago. For these reasons, thinking simply about learning spaces doesn't do justice to the complexity and range of learning that students can experience. Looking at the learning environment is vital to ensuring that all students are able to engage in meaningful learning, regardless of their situations.

This white paper seeks to engage a varied audience. Senior administrators, faculty, the IT community in higher education, university space planners and architects, instructional designers, teaching/learning staff, students, and others are invited to join in examining the learning environment. Development of new goals and directions for innovation in educational effectiveness can serve as common ground for a variety of interests. The hope is that many constituencies, regardless of their proficiency with technology, will begin to see their efforts in a larger educational context, one in which learning happens in many places, at many levels. As these groups think about the student experience and how to maximize the value of that experience, this conversation will hopefully lead to a stronger understanding and thoughtful development of learning environments that have a demonstrably positive impact on student success, learning, and the effectiveness of education.

Paving the Way

The learning space is an appropriate point of departure because it has been the literal center of the educational enterprise and can serve as a familiar basis for a look at the future in learning. The work done around learning spaces has illuminated many ideas about how educators can design effective learning activities that are specific to individual disciplines and institutions. That work has touched on the cultural as well as technological components, but the concept of learning environment remains loosely formed and in need of elaboration. Discussions of learning spaces are inherently limited by the fact that the idea of space, whether real or virtual, is circumscribed. Technology, however, allows faculty and students to think beyond the space of learning and consider factors separated by time or location that influence learning. A traditional view of education held that shelter from distraction was paramount and participation should be limited to those in physical attendance. That vision of education is giving way to one in which conditions placed on who can participate—and hard distinctions about what constitutes appropriate learning activities—restrict the kind and amount of learning that could otherwise take place.

Web 2.0 technologies have multiplied the number of participants in the production of new information, and they greatly extend the reach and circulation of digital objects—video and sound clips, text, graphics, and so forth. By substantially lowering the barrier to creating and distributing content, Web 2.0 tools blur the distinction between providers and consumers of information, and they have created the phenomenon of massive self-generating communities of interest on every conceivable topic. Indirect testimony to the influence of Web 2.0 in the learning environment comes from faculty complaints that network performance is inadequate for playing media streams in teaching spaces or for students to access learning resources from around the world on social networking websites. The classroom is not a box; its inhabitants want to break out from its confines.

Most classrooms now have at least a minimal kit of equipment for mediated instruction—network access, a projector, various media players, and a computer or at least the provision of connection for a laptop and a network port. These technological aids bring more informational resources into the teaching space, and they also extend the boundaries of the room, enabling outreach to other sources of information and indeed to other places. In a sense, the addition of IT in itself begins to transform a space into an environment.

Zoom Out to Learning Environments

The work to implement inspired, technology-enhanced learning spaces continues, and the lessons learned in those efforts remain valid and important. Those efforts inform the discussion of learning environments, but a new set of questions is necessary for this conversation:

- What are the components of a learning environment?
- What is the appropriate role for technology in learning environments?
- How do the roles of instructor and learner evolve and overlap as we move beyond a focus on learning spaces?
- How does the culture of learning influence what a learning environment looks like or how it functions?

- How can we measure success, costs, and benefits in learning environments? What elements of an environment promote learning and why?

Environment Defined

The term *environment* denotes the totality of the surroundings and conditions in which something or someone lives or functions. A discussion about learning environments starts with a physical space, a virtual equivalent, or at least a set of organizational principles that had their origins in a conventionally space-influenced model. Whether a classroom, an island in a virtual domain, or a chat room in a learning management system (LMS), this core place features connections to other places and resources. These might be other learning spaces, but they are also likely to be places outside the educational world. A class in finance might, for example, include a real-time connection to a stock-trading floor. Technology can also provide an interactive, immersive experience, joining language students with native speakers via a teleconference or sending them on a virtual walk through ancient Roman buildings.

A learning environment consists of a wide set of features that affect learning. The idea of a learning environment implies a setting where intentions and design cannot account for everything that happens; some elements escape control or are at least unintended. Environment, then, is a mix of the deliberate and the accidental, the conjunction of planned and unanticipated events. To some extent, traditional teaching in conventional classrooms could support this dynamic—students could be given assignments to take in directions that show mastery but also imagination and creativity. Now, however, with minimally mediated access to large amounts of information and with a substantially enhanced social dimension available to students, the set of directions students can take in their learning is far larger and growing. Some of this change is sanctioned by faculty; other parts of it reflect the environmental changes brought by technology and a tipping of control in favor of students regardless of faculty intentions.

Space becomes environment when it is stretched to include a broader sense of place, as well as the people who participate and the culture in which these elements are situated. The idea of environment invites a wider range of participants: administrators of various levels and functions, faculty, guest experts, librarians, IT staff, instructional designers, and learning theorists and researchers. The term implies a multiplicity of players, forces, and systems interacting. Environment is dynamic—changing in response to influences from outside or arising inside. It recognizes complexity in causes and effects.

Technology

The infusion of information and communication technologies in teaching and learning is one of the primary drivers behind a conversation about learning environments, though many of the fundamental principles involved are equally valid in settings with little or no technology. Understanding the forces that affect learning can help educators implement environments that are appropriate for different situations, regardless of technology. That said, what makes a discussion of learning environments particularly important today is the range of opportunities that technology provides for creating new kinds of learning activities and experiences. The challenge is finding the right places for technology and using it wisely.

Learning spaces have tended to enclose students and shield them from distractions. The ivory tower metaphor derives from the Song of Solomon, where it suggests the purity of intellectual pursuit removed from the ordinary concerns of life. In modern times, the term denotes the semi-seclusion

offered by academic buildings and walls, and strong vestiges of this impulse to retreat from the more materially focused elements of society persist among educators and students alike. Nevertheless, technology today allows people who so choose to stay in essentially constant connection with friends, families, and colleagues through social networks, communication tools, and web-delivered media. Higher education finds itself in a position of balancing the value of a traditional, insulated environment with the benefits for "unbounded learning" that technology can provide.

Capabilities such as visualization, simulation, or computer-controlled musical performance offer new alternatives in teaching academic disciplines. It is possible to engage students in what were traditionally very sophisticated and advanced topics without the need for many years of prerequisites in advanced mathematics or in the memorization of basics and the mastery of fundamental computation, experimental, or performance skills. This break with traditional sequences is not without controversy. Some would say that a piano student should not interact with a computer to perform a piece of music until well after scales and other fundamentals have been learned. Others contend that a glimpse ahead, with the interactive assistance of a computer, can set the stage for the same pedagogical goals by introducing insights and experiences that motivate students and show them the relevance of the hard work on a progression towards mastery. Furthermore, mastery is not always the objective; for example, as a society we need many more people to have a better understanding of science but not necessarily to become practicing research scientists. Authentic-learning environments that encourage students to synthesize knowledge from different disciplines to solve problems are also well served by these tools. Looking broadly at learning environments and the components that influence learning can shed light on this question, helping show where technology is put to best use.

Successful educational use of technology depends both on technical proficiency with a tool—simply put, the ability for faculty and students to make it work—and on pedagogical techniques that capitalize on technology's potential. In some cases, faculty believe that the former will simply take care of the latter—that using the technology within existing pedagogy will be sufficient—but effective use of technology requires modifying teaching techniques to take advantage of the addition of technology. In other cases, faculty who recognize the need for changed teaching methods do not have the time to redesign their courses to accommodate technology, or reliable information about appropriate changes is not available. Faculty innovation with technology is also hampered in many instances by current tenure and promotion systems. Some instructors also need specific kinds of pedagogical and technology support that is not available to them. Institutions that want to provide effective, technology-enhanced learning environments must create a structure of incentives and motivation that encourage faculty to make the investments needed.

Most of the expansion in learning environments in the past decade has been due to faculty adoption of learning management systems (LMSs), which have lowered the threshold of entry into technology-enhanced learning for those whose comfort zone was essentially word processing, e-mail, and web access. Some faculty who first used the LMS to post syllabi, e-mail to the class roster list, and post text documents for course reading are now picking up the use of wikis, blogs, and perhaps online quizzing or even workgroup or e-portfolio modules. Video and podcast sites and virtual reality programs are getting some traction. These are all essentially tools or built environments. Applications with higher thresholds of entry—in terms of skills and time required—remain the domain of those relatively few faculty whose disciplines depend heavily on them or who are self-motivated to explore new tools. Geographic information systems have become standard in geology and geography-based disciplines, for example, but have not spread widely in the social sciences. Scientific visualization has been advanced by the numerical and symbolic applications packages but has not become part of most students' experience of learning in the sciences.

Most of the technological assists in the learning environment have resulted from software that significantly lowers the ease-of-adoption barrier, addresses productivity, or has gained a foothold first in popular culture, as in the case of Web 2.0 phenomena such as minimally edited video, web publication outlets, and social networks. Repositories of digital learning resources—slide and audio collections, course reserve materials, and films on demand—are growing in size and value but are typically built or acquired by librarians or instructional technologists. It is unclear how quickly such repositories will expand and who will maintain them because they require specialized knowledge and technical expertise.

A productive discussion of technology in education must also address the ways in which technology can harm or damage the learning process. Is there a point at which the flow of information and the tools that provide it hinder rather than help the work of learning? When does stimulation give way to distraction? Students who have grown up with technology appear to have a high tolerance for multiple and competing inputs, but our understanding of how this affects learning is inadequate (and our typical misgivings perhaps ill-informed). Anecdotes of technology being implemented purely for technology's sake are not hard to find, and the effort to broaden our understanding of learning environments must consider these and other risks of introducing technology into learning. Absent a new conception of effective ways to teach and learn, technology risks being just a repackaging of the qualities of traditional classrooms, labs, and other learning spaces.

People

Reorienting higher education discussions—away from learning spaces and toward learning environments—involves a careful consideration of the people involved. Because the final verdict on the effectiveness of a learning environment lies in learning outcomes, a focus on people should center on the student experience; on different kinds of faculty, staff, and student interactions; and on changes in faculty roles and rewards. To deepen engagement and maximize learning, educators must strive to understand how students and faculty respond to changes in the factors of a learning environment.

Technology allows higher education to rethink who and where students are. With the help of networks and technology tools, for example, a language course can pair students in one country with those in another to learn each other's language. Working professionals have more opportunities to be students, synchronously and asynchronously. Effective learning environments afford students both an opportunity to reach their potential as learners and the chance to engage in activities that they will encounter after graduation.

As many workplaces adapt to new technologies and models of activity, so too must institutions of learning update their environments so that they encourage students to see themselves as active participants in learning. The ability to overcome distances in time and place means that multiple individuals can serve as instructors for a learning activity, bending the roles of teacher and student. As the model of teaching and learning evolves from the transmission of information to the creation of knowledge, students and instructors become equal partners in the learning enterprise.

In traditional learning spaces—and even in many reconceived learning spaces—the roles of student and instructor have remained relatively fixed. Teachers have always been experts and sources of knowledge, and the teaching space traditionally has belonged to faculty. Social constraints, ritualized interactions in the teaching space, and limited or no contact outside that space were the main features of these social relationships. Control of the learning environment today is less rigid, however, giving faculty new options. Faculty have extended their availability to students beyond office hours

through e-mail, text messaging, and other means. Students at many institutions participate with faculty in research projects and even share bylines in resulting publications. Instructors circulate in classrooms and labs, sitting temporarily with student work groups, and learning places today include outdoor spaces, cafes, museums, art galleries and studios, and many other locations. Quiet deference to faculty has diminished considerably, due in part to a leveling of the playing field: students can tunnel outside the classroom, using their laptops or cell phones to delve deeper into a topic in real time. In many ways, the mores of student-faculty interaction have become more flexible and less predictable in recent years. Intellectual inquiry as a shared activity has largely replaced the notion of transmission of information from masters to pupils.

Technology has played an important, if not entirely anticipated, role in shifting emphasis within the scope of faculty behavior and tasks. Student access to information, and the opportunity for students to choose their own sources, is viewed by many faculty as a mixed blessing at best or a cause for anxiety about students' capability to judge the quality of resources they find. Some have adjusted their role, lecturing less and instead sending students to collect more of that information themselves. Others have responded by limiting the number of online sources they allow students to use. The web browser began as a tool to assist in finding things; it has become a transformer of the learning environment by lessening faculty control of information sources.

Faculty dominance in the learning environment is under pressure from other quarters as well. Institutional mandates to serve previously unreached populations of students force faculty to reassess their methods of instruction and their ability to address the needs of nontraditional students, whether that means older or less prepared students, military veterans, students with learning disabilities, or other groups. Many courses today are not designed solely by the instructor; instead, they are produced by a team of librarians, instructional designers, and media specialists. This unbundling of the course design process has made counselors, tutors, and other instructional support staff important contributors to the education of today's students, a change embraced by some faculty and perceived by others as a decline in their own influence.

Online and blended courses are also changing the balance between faculty and staff in numbers and influence in the learning environment. Institutions and departments that specialize in distance learning typically have a ratio of several technical and administrative staff for each faculty member. These are instructional designers, programmers, graphic artists, and technical support staff, not to mention special marketing, advising, and student-support personnel. In these situations, faculty are members of the team that produces courses, which is a new development in the history of their profession.

For faculty looking ahead to tenure, the changing place they occupy in the learning environment causes some concern. Promotion and tenure are traditionally based on individual accomplishments, without formal recognition of collaborative work with non-faculty. Strong ratings as instructors, grant funding, and suitable publications are the enduring standards. Very few institutions have evaluative criteria for faculty engagement in technology; they generally presume that investment will pay off in either teaching effectiveness or enhanced scholarship.

Many schools also do not have adequate criteria for evaluation of faculty engagement and experimentation in new forms of pedagogy. The conundrum is this: if teaching is assessed only in summative fashion through post-course evaluations, and if promotion is based on those evaluations, then faculty are likely to be disinclined to experiment pedagogically. After all, a failed experiment, leading to unfavorable student ratings for the course, can be costly to a faculty career. Junior faculty consequently hear a mixed message about technology: most institutions want the benefits of innovation in their learning environments but are often not forthright about how willing they will be to

recognize faculty contributions and roles in an increasingly team-structured approach. Worst of all, many research universities focus almost exclusively on peer-reviewed publications as a requirement for tenure, with teaching an afterthought at best.

Adjunct faculty have a different perspective on technology in learning. Their willingness to devote time to technology development increases their value to current and potential employers. Because many institutions now rely heavily on adjunct faculty, their importance in the learning environment is increasing, and they figure heavily in the cohort of faculty working with technology.

Technology has contributed substantially to teacher and student role modifications by facilitating easy access to vast amounts of information. Before the web, for instance, art history faculty had virtually total control over the images that their students viewed—typically, the slides shown in class. Today, a student with a laptop or a web-enabled mobile device can browse the Internet for images, circumventing the vetting previously exercised by the instructor. Web search engines have democratized the expansion of information beyond the basic syllabus. Much of the commentary on this expansion of access concentrates on a perceived inability for students to judge value, but many students identify valid and valuable information without the guidance of their teachers. This is an environment that can be much more challenging for faculty.

Culture

Learning culture is expressed at multiple levels—national, institutional, departmental, disciplinary. Does learning happen solely during class and study time? Are students expected to draw connections across disciplines? Is instruction the province of faculty, or do peer groups and individuals beyond the scope of the institution share in teaching? The answers to these and questions like them are at the heart of learning culture. The cultural component of a learning environment may prove to be the most difficult to understand and accommodate, but doing so is a necessary step in the development of effective, thriving higher education.

Students arrive at any college or university as products—and, to some extent, vehicles—of the learning cultures that they have experienced up to that point. These learning cultures today are tremendously diverse: students come from across the globe; in the United States, homeschooling has become more prevalent; and learning cultures might include corporate environments or military service. Part of selecting an appropriate college is choosing an institution whose culture feels to the prospective student either familiar or appropriately challenging. At the same time, institutions must recognize that the student body represents a range of learning cultures. Colleges and universities should construct learning environments that enable students with a range of cultural backgrounds to succeed. The environments they cultivate should accommodate cultural differences or set minimal standards for students—and provide remedial assistance so they can meet them.

Most people active in higher education today—as faculty, administrator, or student—entered the learning enterprise during the era in which information technology began to erode the intellectual and cultural authorities that formerly held sway. New disciplines emerge; interdisciplinary studies proliferate. The curriculum evolves at a rapid pace—expanded canons and multiple perspectives are the coin of the realm. Generations of students have now reached college through elementary and secondary school environments that feature group and dynamic project-based learning. Lecture and textbooks continue but without the prominence they once had at all levels of education.

Demography is changing the culture of learning as well. Older learners are coming to outnumber students of traditional college age. The cost of higher education requires many students to hold jobs

that keep them very busy and extend the time needed to complete a degree, and the cost of commuting to campus can come into play in a slow economy. Experiences from the world of work and family accumulate for students at the same time they are pursuing their studies. The economy requires greater numbers of "knowledge workers," and members of the workforce increasingly must update their skills to maintain levels of employability.

As institutions grapple with exploring the many facets of learning environments and working to construct new ones that will ultimately benefit learning, there is a central opportunity to cultivate—in students as well as faculty—a learning culture in which the goals of education transcend individual courses or even institutions. We must be careful not to simply think of a learning environment as the circumstances in which a specific course takes place; rather, it might be more appropriate to think of some learning environments at the programmatic or disciplinary level, for example. Students can begin to see education in a new light, one in which learning takes place at many levels and even across disciplines. A student in a history course might draw connections to material discussed in economics or biology courses, seeing how the many pieces fit together and influence one another.

In this way, a new focus on learning environments can facilitate the kind of transformation that educators have for years been calling for. Any learning environment will reflect a set of cultural values about teaching and learning, and understanding these values and the degree to which the design of learning environments will influence the attitudes of students and faculty is a vital part of the broad discussion about learning environments. But the next step is for learning environments to facilitate the development of a culture that breaks learning out of isolated courses or topics and expands it to include all areas of inquiry. Learning is art and science, physical and virtual, local and global. Conceiving and building intentional, thoughtful learning environments will contribute to a culture that puts learning into this context and improves education.

Reflection and Assessment

The discussion of learning environments should also include assessment and evaluation of the effectiveness of the environments that institutions create. Much has been said in recent years about new kinds of learning and new methods of assessing educational outcomes. Adaptability to change, mastery of complexity, and intuition for abstract concepts and objects are some of the mental qualities required in the technology-infused world. Problem-solving, critical thinking, and innovation are among the most-cited general objectives when learning outcomes are discussed. The value of authentic learning is clear, whether sponsored and directed by institutions or acquired by students through work, time off from study, volunteerism, or prior learning experiences. A thoughtfully designed learning environment allows for both authentic learning and appropriate assessment. As new models of learning environments are developed, new forms of learning will emerge, and educators must include assessment as a component of this evolution.

Public pressure for greater accountability for learning outcomes and for the value of higher education sharpens the need to understand learning environments and the factors that have discernable effects on student success. Governments and accrediting agencies have implemented new guidelines to measure learning outcomes assessment, with an eye toward determining whether learning spaces support curricular advancement. This creates an interesting dynamic between educational strategies that favor core knowledge and discipline-specific learning and those that focus on critical thinking, self-motivated and self-guided inquiry, and constant learning. Design of learning environments needs to be informed by these perspectives, and ultimately learning success must lead these evaluations: what contributes to students' mastering academic content, finishing courses, and completing degrees?

Another key element of reflection and assessment is student satisfaction, which is related to but distinct from student success. Even students who complete courses and programs of study can have negative educational experiences. Looking at completion rates—either for entire degree programs or for individual courses—provides quantitative data, but the qualitative aspect—as evidenced by student satisfaction and perceptions about the degree to which learning environments meet all of their needs—should not be overlooked.

Learning environments remind us that educational professionals—the team of instructors, librarians, designers, and technicians—work at the intersection of learning sciences, technology, and innovation. The tools available for the conduct of education have expanded the learning environment, and technology has transformed social, economic, and ecological environments in ways that demand attention to and perhaps the adjustment of traditional educational objectives. Geometry taught with paper, compasses, and pencils, for instance, tends to pose the same problems and elicit the same solutions in most settings. But a different mode of instruction for the same principles might include problem-solving outside the classroom, using tools more sophisticated than the compass. Alternatively, the learning experience might be computer-based, where the pedagogical goal is to enable students to propose problems and solutions. The great challenge is to learn how to evaluate emerging technologies within a cultural and cognitive framework.

Understanding the effectiveness of various models should inform the goals, strategies, and technologies that shape the evolution of learning environments. As we plan and implement learning environments, we must build in processes to reflect on the value of individual components of those environments. If we are successful at measuring the impact of specific decisions about the learning environment, we can investigate alternatives and make appropriate, effective adjustments that will, over time, improve education in our institutions.

Looking Ahead

What, then, does an effective learning environment look like? To be sure, there isn't a single answer to that question, no prescription for how the components of a learning environment should be assembled for maximum benefit. The variables are many, and combinations that work well in one setting won't be ideal at other institutions, in different disciplines, or even in several sections of the same course taught by different faculty. Moreover, the fact that technologies and teaching methods will continue to evolve means that the job of creating effective learning environments is a journey, not a destination. What is clear is that we must begin to think in environmental terms about the factors that influence learning and strive to understand, test, measure, and evaluate how they work together as an interrelated system—an ecology of learning.

To be successful, this effort must represent a coordinated effort from all levels of an institution. The process of investigating and creating effective learning environments is one that depends on participation—and leadership—from faculty, instructional designers, technologists, students, senior institutional leaders, librarians, administration, and others around campus. In many ways, these groups of campus constituents frequently operate independent of one another, doing their jobs in the dreaded silo model. The discussion and work around learning environments is an excellent opportunity to refocus attention on the common goal and discover new ways to work together to attain it. To this end, the following recommendations can be important principles to bear in mind as the journey begins:

- *Think carefully about what you are trying to accomplish*. The construction of an effective learning environment requires thoughtfulness about what you are asking of—and offering to—students who participate in it.
- *Keep an eye on technology*. Information technology is in large part responsible for the reexamination of learning spaces that has led us to now consider learning environments. In many ways, it has been the proverbial game-changer, and technology developments will continue to pave the way for new opportunities to change and improve higher education.
- *Look beyond technology*. Factors including people, culture, pedagogy, and assessment can be as important as technology in thinking about what makes a successful learning environment. In certain situations, a highly effective learning environment might be devoid of anything digital or electronic.
- *Question everything, and listen to all ideas*. The opportunity to fundamentally rethink not just the space in which learning takes place but also the environment that supports education depends on looking at teaching and learning with new eyes. Apostates and experimenters must be encouraged to take risks and push traditional boundaries. A "sandbox" approach to instructional development can encourage emergent phenomena to flourish. The World Wide Web itself is a compelling example of how a non-specific platform can lead to revolutionary change.
- *Reflect and evaluate*. As new ideas are tested, measure the results, evaluate the effectiveness of different models, and demand that technologies and learning environment structures demonstrate their mettle. In the context of learning environments, accountability for the educational effectiveness of IT systems and resources will increase.
- *Implement structures that support faculty*. The role of faculty in learning environments is likely to be different from what it has traditionally been. Institutions must support a program of incentives, rewards, and training that will help faculty become players in a team-based approach to course delivery and skilled using new techniques and technologies. Institutions must also measure faculty engagement and productivity in ways that go beyond simple quantitative measures such as publication credits and student evaluations.
- *Look at the big picture*. The concept of learning environments implies that the many people involved understand how their roles and those of others work together. The IT profession, for example, needs to improve its awareness of curricular requirements and the related cultural changes happening in the learning environment, particularly with regard to the changing roles of faculty and students.
- *IT needs to acquire competencies in pedagogy.* Faculty should see IT staff as partners in the educational enterprise, not simply service technicians. IT should have a cadre of staff, largely academic in background, who can coach, encourage, and support faculty as they develop their pedagogy in new directions. These staff will need to work collaboratively with librarians, teaching and learning centers, and technical specialists.
- *Think about culture*. Work to understand both the culture that exists on campus today and the kind of learning culture your institution might want to cultivate. Creating effective learning environments will depend on implementing structures and activities appropriate to the way students and faculty view learning.

Learning Environments

The exploration of the many factors that influence learning and the development of learning environments that take advantage of the knowledge that results from that exploration offer an opportunity to bring a new understanding to the very basis of education. It is an inclusive process that strives to make more efficient and more effective use of learning technologies, practices, and activities. The traditional classroom isn't likely to disappear but will be part of learning environments that do and far exceed what we've known before.