Participants at the NLII Fall Focus Session, *Learning Space Design in the 21st Century*, were treated to a day and a half of discussion and guided sessions on learning spaces. While participants’ reasons for attending were diverse, most participants intended to gain some knowledge to assist in either creating or retrofitting learning spaces on their campuses.

**Before the Session**

Prior to the session, participants were asked to identify an example of a successful learning space on their campus as well as an example of an unsuccessful learning space. They were then asked to compare the spaces based on the types of learning principles they supported.

Responses indicated that successful spaces took care of the basics—light, creature comforts, or adequate space to move around in. Flexibility (for example, reconfigurable rooms) was seen as important as well; being able to reconfigure rooms within a short time was equally important. Spaces that facilitated eye contact and did not allow students to remain anonymous were also considered successful.

Technology use in the classroom elicited mixed reactions; it was considered both successful and unsuccessful, depending on the implementation. An unsuccessful space often included unwieldy technology without the proper support. Another feature of an unsuccessful space was lack of control over the basics; poor lighting and lack of control over temperature and ventilation were among the most often cited problems. While not unanimous, many considered fixed seating and large lecture halls to be indicative of a poor learning space.

**A Tour of MIT Learning Spaces**

To set the stage for the focus session, a tour of the five different learning spaces on the MIT campus was offered the evening before. Guests toured the Aero-Astro building, the TEAL Lab, language labs, and Stata Hall. Each space was different from the next, but well suited to its intended use.

Although unfinished, the spaces in Stata Hall demonstrated the importance of many features that we would discuss later in the week. Natural light, flexible spaces, and chalkboards were just a few of the important features of the spaces. When questioned about the chalkboards, it became clear that the faculty had insisted on them. (Many participants from other campuses had also encountered this sentiment.)
Defining Terms

The next morning, the focus session started with a statement of assumptions. Malcolm Brown set the tone for the next day and a half by defining the boundaries of the focus session. For the purposes of this focus session we talked about learning spaces that were teaching spaces controlled by the central classroom scheduling system on a campus. While we were interested in technology, we did not limit our imagination to only those spaces with technology.

To help focus thoughts, a taxonomy of learning spaces was created to help identify common categories of rooms and room uses. The list included:

- Large lecture (200–500 students)
- Lecture (80–200 students)
- Seminar, discussion, or small classrooms
- Science labs
- Instructional computer lab
- Performance/studio facilities

The expectation for an NLII focus session is that participants will work and collaborate; answers are not provided. Attendees work through exercises designed to elicit concepts and to identify misconceptions about learning spaces.

Challenging Misconceptions

Following the initial definitions, attendees broke into smaller work groups, allowing participants to reflect on the homework that had been submitted. In small groups, participants shared their observations on spaces from their home institutions, concentrating on what space characteristics enabled learning.

What was important about our learning spaces? Themes that kept surfacing centered around the technology and the physical space: sightlines, flexibility, projectors, podia, and laptop stands all emerged as important aspects of a learning space. Deeper issues included getting the technology to perform as desired.

What Is a Design Principle?

Steve Ehrmann and Nikki Reynolds set the stage for the rest of the day by leading us through a quick definition of design principles. As we would be spending much of the day determining principles of good design, it was important to determine what a principle was, and more specifically, how a good design principle might help facilitate the implementation of a good learning principle. Ideally, it was important to think of our spaces in terms of the behavior that was desired rather the physical attributes of the space. Under this definition, a requirement for a whiteboard and projection system became a space that would permit students to view slides, video, and other media concurrent with viewing instructor notes.
Case Studies

Case studies were used to begin surfacing principles. Malcolm Brown reminded us that in a constructivist view of learning, learning is active and consists (in part) of reconciling new information with existing information. Drawing on the work in the book *How People Learn*, Brown observed that issues such as the learner’s context, the paradigms in which the knowledge sits, and metareflection about learning were all important factors.

Brown noted that by looking at our teaching and learning spaces differently, we could make a lot out of what appears to be very modest. The most important factor is to engage students. Knowing how our students learn (and don’t learn) is important for all aspects of higher education, especially setting up the spaces to promote it. In *Dead Poets Society*, the teacher played by Robin Williams is able to engage and inspire his students by the simple act of changing his perspective (by standing on his desk). Brown encouraged us all to change our perspectives, as well.

To make the connection between how people learn in a constructivist environment and learning space design, Brown referred to the book *In Search of Understanding: The Case for Constructivist Classrooms*. This book takes the approach of listing good learning principles along with examples of their implementation. For example, in order to encourage student autonomy and initiative, a classroom should be designed with some flexibility and with the ability to be customized. This might be accomplished using paired tables instead of individual, fixed seats. It might include a mobile computer arrangement. Consider another example: In order to allow student responses as input into a class, it may be important to have real-time polling. The acoustics of the room as well as clear sight lines are also very important for capturing and promoting student response.

Phil Long of MIT followed with an analysis of the Aero-Astro engineering facility at MIT. In his presentation, Long recounted the process of redesigning the space that houses the Aeronautical and Astrophysics Engineering department. In the redesign, it was important to assess what was currently occurring in the school and to design a space that could enhance and promote this. It was important to identify relevant learning principles and to assess how the space was currently being used. These findings needed to be integrated with the mission and values of a number of people from the community.

Chris Johnson spoke about the University of Arizona’s experience with their first-year building. The Integrated Instructional Facility was conceived as a solution to the problem of first-year student retention. Once the vision was set, a big challenge was identifying the people who needed to be involved to communicate, propagate, and maintain the integrity of the vision to see the project succeed.

Dan Gilbert presented his findings from Wallenberg Hall at Stanford. With almost three years of experiences the “Wallenberg Hall experiment” was a rich source of emerging data about designing “More than a Room.” Of critical importance was the ability to assess and evaluate the uses of the spaces. The spaces had been designed to include breakout and prototyping spaces, and the experiment was designed to see what faculty
would do with the space. Faculty members were able to use a space three times to experiment, develop, and productionize their use of the space.

**Practical Considerations on Learning Space Principles**

Participants were asked to identify the principles from the case studies. They were also asked to consider how these principles might translate to their own campus and to think about the practical considerations that may impact learning space principles.

**Rethinking Campus and Classroom Design**

Bill Mitchell from MIT opened his talk with a bird’s-eye view of the University of Virginia. Set around an authoritative and communal public resource (the library), architecturally the University of Virginia set the tone for what was expected of it from both the general public and the university community. The University of Virginia incorporated communal and public spaces and invited the general public to make it their own. Mitchell then analyzed a bird’s-eye view of the MIT campus. In this case, the architect chose to emphasize a slightly different culture. The centerpiece of the university was the laboratory.

Mitchell noted that successful learning spaces, in this case buildings, were complex, varied, and needed to reflect the diversity of their constituents and their particular needs. No one size could fit all. It is important to “listen” to the needs of the audience and to design accordingly. Mitchell observed that new technologies had become discreet enough to allow their unobtrusive integration into our new learning spaces. While the technology had already created new patterns of social and intellectual interactions, it could conceivably disappear from prominence in the classrooms. This would allow architects and designers to focus on the human requirements of these spaces.

Using Stata Hall as an example, Mitchell cited the variety of spaces incorporated into the design. Stata is made up of many microenvironments; its complexity reflects the complexity of the interactions required to take place within. It is also designed with human needs in mind. Details such as a place for food trucks to pull up and service the building occupants emphasized that the space needs to serve its human inhabitants. The inclusion of a day care also brought the sound of children and play into the building.

The value of designing affordances to support organic and emerging uses was exemplified in Stata Hall, but is evident in most learning spaces. Noting that the entire campus becomes (or is rediscovered as) an interactive learning device, Mitchell emphasized that in order to fully support human activity and human patterns, it was important to recast humans as inseparable from their technology. Pervasive networks, computers and other devices are important; equally important is the flexibility to accommodate new and emerging social structures around the use of these devices. While important to include, technologies are now taking their rightful place in social interactions, firmly in the background.
The Convergence and Future of Learning Spaces

What assumptions do we bring to learning space design? How can we challenge these assumptions? Mark Valenti of the Sextant Group challenged us to take a long hard look at the technologies that are important to us, and then consider a future where the institutional learning environment does not include buildings and classrooms. Valenti reminded us of science fiction writer William Gibson’s phrase, “The future is already here, just unevenly distributed.” Indeed, seeing the future is easy to do if you know where to look. Perhaps we should look in the hands of our students.

What evidence exists that the future is here, and how might this impact our learning spaces? Valenti noted that the participants in the room were already loaded to the hilt with technology. In addition to the obvious technology in the room (laptop computers, projectors, and the wireless network), there was the technology that was quietly sitting in our pockets and at our hips. This is the future that is upon us already. Our ability to network in increasingly transparent ways is one obvious sign that things are changing.

What might be less obvious is the fact that technology is sneaking up on us through entertainment. In the best applications, useful and powerful technology is effecting change in users simply by being fun and social! Retelling a story from dinner the night before, Valenti observed that by comparing the capabilities of their respective Treo 600 PDA/phone devices, dinner guests were training and tutoring one another in very sophisticated technology.

What technologies will help us recognize when we have arrived in the future? Some things to watch out for include greater bandwidth available everywhere that will allow us to communicate in a visual and/or filmic language. Increasingly small devices will continue to allow their integration into and eventual disappearance from our day-to-day activities. The act of accessing data will no longer be tied to a particular time (at work) or location (the office) but rather take its place alongside other “natural activities.”

The potential impact on education is huge. Information technology has the potential to completely transform the institution; once the change is begun it may be difficult, if not impossible, to stop. Given the changes occurring in networking, data capture, displays, and ultimately, “presence,” Valenti suggested that students would no longer need to come to a class to learn. Rosemary DuMont predicted that while students may not come to class to learn, they probably would come to campus to study with their peers.

While technology promised to change significantly, what would likely not change was the march towards greater reliance on rich media in the classrooms. A/V demands shift the focus to quality of life within learning spaces. Technology could disappear into the walls, but the demand for high-quality “recordings” of lectures, simulations, and other educational material would drive the design of our classrooms in the future. As well as being optimized for acoustics and flexibility, provisions for “blended” learning for an increasingly nomadic student and faculty population would need to be in any new
learning space. In summary, any new learning space should be built with the assumption that it would last 30 times longer than any technologies that would sit inside it.

**Using Learning Spaces to Engage Deeper Learning**

What areas can we make the most progress in improving teaching and learning? Which of these might be most applicable at your home institution?

The aptly-named book *How People Learn* summarizes years of research about how our students learn. One of the findings elucidates the difference between experts and novices. For example, experts organize information in textured and layered hierarchies. This structure allows them to notice and assimilate large amounts of new knowledge by reducing it and finding places to “file” it (called chunking) in the context of the existing knowledge. This knowledge base allows experts to determine the best way to solve a problem, and their knowledge allows them to understand “better.”

One implication for this is that students need to have their educational content organized to permit more efficient assimilation. Problems can occur when students are exposed to information that does not fit with their belief system. Transferring knowledge, though not an easy task, can be made easier by applying knowledge in more than one context.

What are the implications on the classroom? Classrooms need to focus on the learner. Assessment of students needs to be built in to monitor and allow self monitoring of learning progress. Making thinking visible to peers, teachers, and one’s self is important. Keeping the overall goal of learning spaces in mind is particularly important and it becomes difficult when a space is designed without some knowledge of its intended use.

What might this look like? Mestre spoke about opportunities for learning. Teaching might incorporate interactive techniques. The class could be run cooperatively or as a collaborative endeavor between faculty and students. Interactivity and active learning could be facilitated through the use of response system devices.

An emerging “science of learning” reveals much about how we learn and what conditions enhance learning. It is important to be aware of this data and the implications on teaching and learning in general, as well as on learning spaces and their design.

**Bringing Professionals onto the Team**

Carol Wedge shared some of the experiences of her 18 years as an architect. Currently with the architectural firm of Shepley, Bulfinch, Richards, and Abbott, Carol spoke about the design process from the point of view of an architect. When it comes to technology and space, Wedge echoed the sentiments of others and succinctly stated that technology is like electricity (specifically, in the background) and urged participants to spend time on the fundamentals of designing a space. Wedge identified the design process as one that must include identification of the existing facilities and needs, as well as some form of benchmarking, analysis, and synthesis.
Wedge emphasized the importance of finding the right people to contribute to the initiative and aligning with the appropriate institutional strategies. Questions such as “Where does learning take place?” and “What do we currently have serving as our learning spaces?” are useful to help focus the correct people on the task of envisioning a new space based on needs. Wedge emphasized the importance of getting off campus and visiting other spaces. Exploring the concept of flexible learning spaces, Wedge urged consideration not only of the potential of spaces but also of practical considerations such as exactly how long will it take to transform a room from rows of seats to paired tables and how much transition time exists between uses of the room.

Looking into the future, Wedge sees spaces that support increased collaboration and are supported by exciting tools including visualization tools and displays, as well as those that promoted simulations and interactivity (presence).

**The Conceive, Design, Implement, and Operate Approach to Learning Space Design**

Ed Crawley, the executive director of the Cambridge–MIT Institute, and Steve Imrich, associate principal from Cambridge Seven Architects, gave an analysis of the overhaul of the Aero-Astro building at MIT. The overhaul process modeled engineering principles, starting with a need and following through with the engineering processes of conceive, design, implement, and operate (CDIO). Using the same approach employed for an engineering project, the space redesign team set out to identify the need and to then apply CDIO to the solution.

Believing that creating a space to support learning was akin to delivering a product, the redesign team set out to conceive, design, implement, and operate this new learning space. One of the first steps was to identify what was required and determine the best way to supply this. Particularly important in this stage is the external referencing of the project; by looking at what is going on elsewhere, the project can generate support within the campus.

Recognizing that every student learns all the time—and that every setting could potentially be a learning environment—the team set out to determine what was actually required by their students by observing their interactions with one another and with the learning spaces.

The team then set out to prototype different spaces supporting different learning styles. While experimental in spirit, some key values included community building, knowledge discovery, authentic scholarship, and good exposure to disciplinary knowledge. Also important was the involvement of distinct units with an overlap, including the library.

Lots of glass was included to allow for natural light and ventilation. Space was kept flexible, with larger areas capable of being partitioned into smaller ones. Areas where small groups of students could gather in close proximity to faculty were set aside. Effort was placed into getting “fresh eyes” to bring a new perspective to the environment.
One overarching principle was that of the “Grand Experiment.” The Aero-Astro experiment was established to allow investigation into learning. Flexible spaces were preferred and were created to observe what emerged. The results were surprising. A student community took hold in the space. Student use ended up transforming the vision within six months.

Reflecting back on the process, Crawley noted that it had an organic feel to it. Students and faculty took ownership of the process and moved it along faster than expected. Crawley mused that the design and retrofitting process could likely have occurred one room at a time, with each room engaging the community and developing a larger following for the next.

Design Principles

To finish up the session, participants were asked to share learning space principles. Using scenarios to help elicit ideas, participants were asked describe a learning space, the type of activities that should go on in the space, and the design principles that would apply to creating this space. The taxonomy of learning spaces listed at the beginning of the session was used to help differentiate solutions.

Learning space principles were identified, shared, and contrasted with the ones identified earlier in the session. Important features of learning spaces included spaces that could promote interactions between occupants, that were flexible, and that supported different learning styles. Transparency and openness, both physically and of the processes occurring in the room, were considered important. The support of authentic disciplinary problems was critical.

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<tr>
<th>Category</th>
<th>Principles</th>
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<tr>
<td><strong>Learning activities</strong></td>
<td>• Support multiple modes of learning (discussion, experiential, reflection)</td>
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<td></td>
<td>• Should support authentic, project-based activities</td>
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<td>• Space aligns with curricular change</td>
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<td>• Take advantage of the rooms providing secondary learning (for example, use the walls for artifacts)</td>
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<td><strong>Connections inside and outside the classroom</strong></td>
<td>• Facilitate face-to-face and online discussion within and beyond the classroom</td>
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<td>• Enable interactivity between different science groups and activities</td>
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<td></td>
<td>• Maximize the ability of faculty to get into the social space of every student; avoid lecture hall feeling; “there should be no back of the room”—no hiding places for students</td>
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<td></td>
<td>• Enable interaction with teammates, external experts, and others</td>
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<td>• Integrate librarians, along with faculty, staff and students</td>
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<td>• Make the activity of the group visible to the outside world</td>
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<tr>
<td>Category</td>
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| Display and capture            | • Ability for faculty and students to display multiple types of resources simultaneously; do it easily, simply and with continuity across spaces without being tethered to a physical location; distributed presentation control  
• Ability to capture both the formal and informal work and interactions |
| Flexibility                    | • Space should be easily reconfigurable in a short period of time for group and individual work; without losing power, networking, and so forth  
• Support nomadic learning activities  
• Have facilities open 24 x 7; maximize use over time |
| Comfort, safety, and functionality | • Accommodate the learner’s notion of comfort  
• Provide students with adequate functional work space (for example, room for laptops and elbows)  
• Must be fully accessible  
• Include space for storage  
• Meet safety and security needs  
• The space should be explicitly designed for sustainability (for example, long-term costs for supporting the space) |

In most cases, classrooms should interact with technology as a “socket.” The appropriate technology could be plugged in when needed and should always maintain a low profile. Multiple modes for representing knowledge, possibly through multiple displays, were important, as was ready access to media and possibly “presence.”

Over the day and a half, the discussion subtly shifted from physical attributes of rooms and buildings to focusing on the needs of the learners inhabiting the spaces. Values such as authentic, project-based work with transparency and sharing throughout were very important. Spaces needed to anticipate and accommodate the needs of future users. The flexibility to support nomadic users who required ubiquitous connectivity and would expect to employ multiple modes of learning was considered essential.

A topic just outside the scope of the session was informal learning spaces. How do these spaces fit into a discussion about learning spaces? It is clear that much of the college/university experience (including learning) happens after hours. What is the role of informal learning in higher education?

While many of the sessions encouraged careful consideration of our student needs, what was not clear was what these needs actually were. Who are our students? How are the students of today learning? How will the student of tomorrow learn? Is this different from students in the past?

**Conclusion**

Participants came away with a better understanding of the components that must come together to create effective learning spaces. Among the insights participants shared were:
• Changing practice is harder than changing technology or space, but new spaces and tools can inspire people to change their practice.
• It is important for everyone at the university to focus on what together we can and should do to improve learning. “It’s the outcome, stupid!” The learning space design implications of this are a part of the larger puzzle.
• It is important to include students in design process and gather ongoing feedback from students. We need input from others too, but we tend to neglect student input.
• Changed teaching environments will push changes in teaching.
• Prior to this session there was a tendency to look at the equation from a technology and not a people perspective. Going forward the perspective should be more balanced.
• Designing teaching spaces is not easy. It involves collaborative effort from multiple groups on campus discussing the teaching and learning styles of faculty and students, both now and in the future. People must be encouraged to challenge existing assumptions.
• When designing learning spaces, review and understand the social dynamics of the space before making any classroom design decision.
• Space is only part of the problem/solution to the transformation of teaching and learning. People, curriculum, teaching methods, and assessment are at least as important.

Although most came to the session focused on physical attributes (heating, lighting), all left thinking about learning and the activities that will create the most effective learning environments. As one participant said, “It’s about the learning (stupid!), not the physical space.” Many expressed the intent of returning to campus and engaging a broader team to ensure that student learning needs would be met through learning space design.