Flexible Space & Built Pedagogy: Emerging IT Embodiments

Torin Monahan, Rensselaer Polytechnic Institute

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Introduction

This paper analyzes the convergence of information technology infrastructures and traditional educational spaces and proposes flexible criteria for material-virtual, hybrid learning environments. My analyses are informed by a year of ethnographic research with Los Angeles Unified School District (LAUSD), from 2000 to 2001, where I studied network infrastructure design projects across spatial, pedagogical, and political domains. I assume that built environments afford conditions of practice by their very design (Weisman 1992), and that these affordances embody political values that translate into learning activities.

Given these premises, I seek answers to the question: what types of structures enable more equitable learning environments for all students? This essay argues that emerging technologized learning environments must be designed with flexible criteria in mind if they are to foster multiple types of learning practices.

Flexibility in Educational Architecture

When architects employ the term "flexibility," they often make distinctions between physical properties internal to schools and abstract social forces impinging upon school design (Ehrenkrantz 2000; Fiske 1995; Leggett et al.1977). Under this rubric, physical flexibility refers to the adjustability of a space to the practices of individuals, such as meeting the special sensory and/or mobility needs of students. Movable furniture and walls, or re-configurable buildings, rooms, and passageways all represent this type of physical flexibility.

On the abstract level, flexibility refers to the ability of built space to accommodate for unforeseeable changes such as demographic shifts, community needs, or policy mandates (Moore & Lackney 1994). The concept of a school facility mediates between these internal and external extremes by connoting the material presence of buildings and their relationships to larger social structures, such as school districts or communities.

The concept of flexibility finds widespread use in architecture literature because it embodies the plasticity that it seeks to describe — one can readily adapt it to one's own purposes. This malleability makes the term valuable in communicating properties of space with multiple audiences (everyone has some conception of its meaning) yet simultaneously obscures the complexity of its signification and the degrees of its potentiality. In order to evaluate the practice possibilities of built spaces, I subdivide flexibility into five properties of space: *fluidity, versatility, convertibility, scaleability, and modifiability*.

Flexible Properties of Space

Fluidity *represents the design of space for flows of individuals, sight, sound, and air.*
Open spaces lend themselves to fluidity, yet they can hinder fluidity if they seem oppressive in their expansiveness. In these instances, well-placed screens in classrooms, for example, can increase a sense of intimacy while triggering curiosity for the space that flows around the screen (Caudill 1954: 137). Such a space then becomes more engaging and less overwhelming. Well-placed windows can also increase a sense of flow and connection between spaces.

Versatility *indicates the property of space that allows for multiple uses.*
Cafeterias, auditoriums, and "multi-purpose rooms" signal one mode of versatility, but versatile spaces such as these run the risk of homogeneity. Since all spaces afford certain activities and flows, generic spaces without any overt indicators for specific use require extra effort, pedagogical or otherwise, to achieve the tone or rhythm of specific uses. Individuals must invest more energy to work within these spaces, because the spaces do little work on their own. For example, performing a play in a generic auditorium requires the investment of added decoration and props in addition to individual suspension of disbelief in order for that production to succeed.

Convertibility *designates the ease of adapting educational space for new uses.*
Educators must often convert spaces to accommodate for changes in enrollment, curriculum, or pedagogy. Modern office buildings are commonly proffered as models of this type of convertible space, because they possess a core with HVAC (heating, ventilating, and air-conditioning), electrical, and communication systems that is surrounded by a shell containing easily re-deployable space for varied activity programs (Brubaker 1998: 31-33). Space designed for convertibility requires an imagination for future eventualities; it should possess a degree of modularity and open-endedness at a structural level — a design open to re-design by others.

Scaleability *describes a property of space for expansion or contraction.*
For expansion, schools may require annexes and additions to meet the needs of increased enrollment or curricular alterations. Tightly coupled spaces (rooms, corridors, etc.) may utilize space efficiently in the short run but present costly obstacles for later growth. For contraction, as space needs decrease, schools should be able to temporarily convert buildings and rooms to other community or business purposes. For example, surplus school space can be leased out from year to year so that when space needs rise again, schools can re-convert buildings for educational programs (Brubaker 1998: 22).

Modifiability *is the spatial property which invites active manipulation and appropriation.*
Spaces that lend themselves to quick reconfiguration are comprised of mobile components such as walls, partitions, furniture, and equipment. Highly modifiable spaces invite imaginative experimentation to coordinate space and subject matter with the specific learning needs of different student populations. The design of such spaces requires much forethought, because these spaces must take into account many structural dependencies such as ceiling configuration for lighting and air circulation, floor materials for ease of partition movement, and so on (Leggett et al. 1977: 104-6).

Emerging Information Technology (IT) Embodiments: Fluidity and Versatility

Public high schools have been coping with severe resource challenges and spatial deficiencies for the past decade. These needs have been coupled with public mandates for technology use in school, and in some cases technology is perceived as a solution to spatial crises.(2) Educational facility planners have responded to this "need" with a series of conferences and publications to assist architects in creating the "classrooms of the future" (Nair 2000; Valiant 1995).

Flexibility in this technological context poses new types of challenges to facility planners, as classroom design must now take into account the place of electronic infrastructures in addition and in relation to existing teaching and learning structures. This section will employ the framework of flexibility developed above to analyze emerging hybrid spaces.

Fluidity in material/virtual hybrid school spaces emphasizes the flow of information and symbols, not bodies or senses. Computer network connections extend the reach of students beyond the confines of classrooms, yet this fluidity is constrained by the lack of physical explorability. The "windows" of computer monitors may invite students and teachers to escape, but bodies remain inert during this escape, and the paths the imagination may follow are bounded by network connections and logics.

Most hybrid spaces do not currently enhance fluidity through movement. For example, distance-learning classrooms often require students to remain within a video camera's limited field of vision (Waltz 1999). Because students sitting outside of this field are invisible and thereby "absent" to class members at other physical locations, instructional "ushers" must prevent students from sitting in these areas. The confluence of space and technology in this example constrains fluidity by restricting individual mobility.

Currently, the network infrastructure of most hybrid spaces limits *versatility*. In wired classrooms and study areas, for example, desks have a limited range of mobility because of their physical ties to cables, and this limited mobility poses an obstacle to multiple-uses. Perhaps the advancement of wireless technology will increase the versatility of hybrid spaces, but one must keep in mind the ways that wireless technologies function as part of larger infrastructures and may diminish other aspects of flexibility in their use.

For example, discussions about wireless laptop use in LAUSD had to take into account factors such as the need for carts and/or cases for the laptops, policies for replacing the fragile devices when broken, higher repair and maintenance costs, periodic battery replacements, electrical charging facilities and routines, and more. In addition to cost, then, district policies and specifications often make the design and regulation of high-tech classrooms extremely burdensome, but these social elements of the design process must be included in evaluations of learning spaces (Monahan 2001).

Convertibility, Scaleability and Modifiability

The planning for information technology infrastructures presents a serious *convertibility* challenge. Rooms must be wired for the communication and electrical needs of supplying network access, furniture must be redeployed to facilitate computer use, collaboration, and instruction, and lighting must be modified to alleviate glare problems (Graves 1993). Many spaces were not designed with this type of convertibility in mind. Space designed for convertibility, then, requires of architects an imagination for future eventualities. Additionally, such space calls for a degree of modularity and open-endedness at a structural level — a design open to re-design by others.

One of the main challenges to information technology convertibility is cost. In LAUSD, for example, technology projects for converting and equipping classrooms cost $403 million over 2000-2001 alone, not including the $16 million spent on technology "instructional programs" (Konantz 2001). Some facility planners have suggested partial solutions for overcoming future convertibility problems — trellised scaffolding for wires (Ehrenkrantz 2000), raised floors for access to wires or re-wiring, and dispersed storage closets for hardware (Graves 1993) — but these simply multiply present costs for the cash strapped L.A. Unified without alleviating current conversion difficulties.

The potential of hybrid spaces for *scaleability* is neatly divided along material and virtual lines. The physical infrastructure of technologized spaces defies facile expansion or retraction in response to immediate or projected needs — such rooms or buildings are generally hard-wired for particular uses, and alteration comes at great expense. Conversely, the virtual component of such spaces affords a great degree of scaleability, especially in terms of storage space for data, electronic resource sharing (e.g. free virtual libraries), and commercial offerings (e.g. online instruction, lesson plans, or evaluation packages). It should go without saying, however, that scaling-up virtual instruction cannot serve as a substitute for providing adequate physical learning environments because the social experience of learning is radically different (if not diminished) in the virtual realm, and because all virtual experiences are ultimately embodied ones.

Modifiability requires convertibility as a requisite spatial property. Because hybrid spaces display such restricted convertibility to date, modifiability is extremely scarce. However, since modifiability represents the property of space for appropriation through practice, it contains areas of promise for technology and pedagogy.

For instance, when a technical institute in upstate New York (3) mandated that all entering freshmen purchase laptop computers in Fall of 1999, students in large lecture halls used the computers to escape from the class by playing games or accessing the Internet. When interviewed, students explained these activities as ways of coping with oppressive learning environments that failed to challenge or engage them, so the laptops rendered root educational problems visible rather than creating "the problem" of student distraction (Monahan 2002).

In this example, the presence of laptop computers in traditional lecture halls catalyzed a type of space-time compression (Harvey 1990) whereby students virtually left the classroom while remaining physically present; they would also enter classrooms virtually to communicate with fellow students or to access on-line readings. These escapes and entries altered classroom power relations but they also created serendipitous opportunities for new classroom practices, such as cross-class collaboration.

Virtual Presence

The laptop computer example demonstrates the inseparability of virtual from material practices. The virtual is always embodied in some material form that takes up space (such as computers, projectors, cables, hubs, switches, servers, etc.). The virtual is always comprised of social relations (funding policies, standards, organizational structures, pedagogies).

Finally, the virtual always has a symbolic component that ties it to culture (e.g. the Internet problematically comes to represent an electronic frontier of infinite possibility for individual gain (Eubanks 1999). In a word, the virtual always has a *presence*, so there can be no purely virtual education, only hybrid spaces.

The analysis of flexibility within material/virtual hybrid school spaces reveals another dimension of built pedagogy. The convergence of educational space and information technology embeds educational practice within larger global flows of information and capital. The expense of these hybrid spaces requires new levels of government and corporate subsidies, new funding policies, and new bureaucratic structures to manage the design of educational spaces.

In the classroom, the expanded access to information necessitates innovative contextualizing pedagogies. Teachers must ground the information that students access so that coherent meanings emerge, so that learning is itself explicitly embodied. These new flexible spaces must also be thought of in terms of the practices they evoke. As calls for hybrid flexible spaces increase, planners sensitive to the relation among built spaces, pedagogies, and practices must carefully evaluate the lessons that such spaces teach. Spaces celebrating individuality and advancing the myth of disembodied information constrict learning possibilities in ways that may damage ideals of social responsibility within communities.

Built Pedagogy

Educational architecture literature grounds itself in a conviction that the design of built spaces influences the behaviors and actions of individuals within those spaces. To a certain extent, these spaces embody the pedagogical philosophies of their designers:

Designs for classrooms not only tell us much about the didactic means that were used in them; they also reveal the essence of the pedagogy that directed the educative efforts of past times (McClintock 1970: 2).

This passage implies that a well-trained eye can read these spaces for the pedagogies they facilitate. A classroom with neat rows desks embodies pedagogies or "tacit curricula" of discipline and conformity, whereas spaces personifying the flexible properties discussed thus far can be said to embody pedagogies of freedom and self-discovery. I call such architectural embodiments of educational philosophies *built pedagogy*.

Built pedagogies operate along a continuum between discipline and autonomy. On the disciplinary side, they can restrict learning possibilities by not allowing for certain movements or flows. For example, desks bolted to the ground make flexible interpretations of spatial use extremely difficult, and they impose directions for how space should be used. In the middle of the discipline/autonomy spectrum, there are built pedagogies that enable but do not require flexible behaviors: movable partitions and desks illustrate space left open to interpretative use. Finally, on the autonomy end, open classrooms invite and almost demand that individuals appropriate space to their perceived needs.

We can say that like technologies, all spaces are underdetermined in that they send messages to users about appropriate behavior yet remain open to degrees of interpretation (Pfaffenberger 1992). Bolted desks can be unbolted, after all, but their particular affordance (or valence) (4) for "proper use" requires more energy to re-interpret than that presented by less rigid built spaces.

If spatial configurations can be viewed as systems comprised of built forms and artifacts, and these configurations of space can contain values such as discipline or freedom, why can't the same be said of technological spaces? In the architectural community, trepidation at taking this next interpretive step inhibits productive readings of flexibility and possibility in emerging learning environments.

For instance, some educational planners posit that "Technology is value-neutral" (Fiske 1995: 8) or that they are merely "tools" (Brubaker in Graves 1993: 6). Such assertions ignore the ways that technologies become integrated into material infrastructures and create contexts for practice *at least as much* as other elements of the built world.

Heterogeneous Architects

As the concept of flexible design shifts to include technological spaces, positions for heterogeneous architects (5) emerge. By this I mean architects who take responsibility for the social conditions engendered by hybrid spaces and include collaborative technological design within their purview. This participatory design position cannot be fully realized until technologies are seen as non-neutral yet contingent components of the design process (Sclove 1995).

Unfortunately, facility planning literature reveals technological determinist (6) standpoints that obstruct such developments:

your ultimate goal should be to design a flexible system that will allow growth as resources become available and as technology continues its rapid, inexorable transmutation (Valiant 1995: 59).

The building of educational spaces need not blindly accommodate emerging technologies at any cost to learning. Heterogeneous architects should instead use flexible criteria to evaluate possible designs and apply a similar flexible framework to include user participation in the design process.

Architects can build flexible educational spaces that accommodate for technological changes and future needs in several ways. They can imagine likely future learning activities and then design space to actualize such imaginings (Valiant 1995: 61), or they can collaborate with users through participatory design to ask what kind of learning spaces are desirable and why, and then design to bring those spaces into existence.

This latter mode of designing demonstrates the role of the heterogeneous architect. She or he attempts to overcome cultural limitations placed upon imagined possibilities by working from the ideal to the actual. By questioning current design trajectories, the heterogeneous architect conducts a normative and self-reflexive envisioning to increase learning opportunities within new built pedagogies. In other words, this type of architect would create flexible spaces that called attention to the embodiment of all information and the political affordances of all technologies. This self-reflexive envisioning (subjecting one's design practices to serious scrutiny and modifying them as a result) would create room for alternate design trajectories and alternate designs.

Flexible Space and Flexible Practice

Some designers might respond that the creation of flexible spaces does not guarantee flexible practices. This is where the imaginative challenge of my final attribute of flexibility comes into play. Modifiability implies a space that invites alteration and appropriation by design.

For instance, what would it mean to have decentralized room controls or furniture that required reconfiguration after each use? A design that motivated students to actively re-structure educational space and practice would serve a dual-function of teaching students design awareness and design abilities in the broadest sense. Students would learn to participate in designing the (learning) structures that shape their own lives.

Since imagining difference presents a serious cognitive obstacle to professional and student designers of space, the introduction of simulation technologies could push imaginations toward different and unfamiliar space-practice configurations. Simulation programs that accounted for room variables and constants could generate random sketches of possible designs and the probable clusters and flows of individuals within those designs. Simulation technologies could become another component of wired educational spaces, or these randomly generated schematics could be printed and made available to users of educational spaces, perhaps affixed along the walls so that instructors or administrators could not hide the learning possibilities open to students.

The types of flexible designs advocated here do not imply "anything goes." Even flexibility can become dogmatic and lose its ability to create equitable learning spaces in the process. Moreover, the concept of "flexible structures"is an oxymoron and a design paradox: the limits of flexibility are structural, so spaces can only be flexible to the extent that they are unstructured. One can engage this design paradox by seeing spaces as inseparable from the practices they enable and from the larger social contexts they operate within (Lave & Wenger 1991).

Flexible Ideologies and Flexible Students

As a note of caution, the practices occurring within flexible spaces can also reinforce student disempowerment through the solicitation of their participation in self-exploitation. For example, Brubaker (1998) predicts an emergent form of built pedagogy that would mold students into holonomous individuals who are:

...capable of living and working successfully in a dynamic and unpredictable future. Holonomous individuals . . . are simultaneously successful at independent and interdependent tasks, an idea that embraces a reality that is emerging for twenty-first-century America (194).

The idea of spatial practices that create holonomous individuals should give us pause. Many social scientists have noted how these types of flexible individuals are subjected to new forms of exploitation in a "late capitalist" era of temporary employment, just-in-time-production, and labor outsourcing (Martin 1994; Ong 1991; Harvey 1990).

An alternative flexible spatial practice is that of *sociality* (Patton 2000). Sociality conveys student empowerment through active participation in structuring, with others, the conditions of his or her life. Where pedagogies of *self-actualization* imply an essential individualist core that can flourish or come-into-being under the proper conditions, sociality recognizes that identity construction is inseparable from the relationship between individuals, spaces, and practices.

Sociality is a state of collective negotiation of the built world for the purpose of mutual empowerment. Sociality pedagogies and spaces stress student flexibility for collective empowerment and learning rather than individual empowerment through market adaptation and acquiescence.

In conclusion, the concept of flexibility holds educational promise for the design of diversely enabling learning environments. As architects and planners grapple with the challenges of material-virtual hybrid spaces, they can use the categories of flexibility outlined in this essay to push design imaginaries. Evaluating designs with the flexible criteria of fluidity, versatility, convertibility, scaleability, and modifiability requires designers to imagine spaces that transcend functionality or comfort. These imagined spaces must also take into account how individuals interact with the material and technological built environment to create meaning.

The practice of translating flexibility into built form becomes a politically responsible act. It acknowledges the politics of built pedagogies and then works to create built spaces that shape empowering classroom practices of sociality.

Abstract and References

Abstract

This paper analyzes the convergence of information technology infrastructures and traditional educational spaces and proposes flexible criteria for material-virtual, hybrid learning environments. I develop the concept of *built pedagogy* to account for the ways that built environments teach values through their constraints upon social action and interaction and suggest ways that the built pedagogies of hybrid spaces can facilitate learning by inviting students and teachers to participate in the continual re-design of learning structures.

Notes

1. This paper grew out of a seminar on design at Rensselaer Polytechnic Institute (Spring 2000). Earlier drafts were presented at an invited talk at SUNY, Buffalo (Spring 2000), at the Participatory Design conference in New York City (Fall 2000) and at the Committee on the Anthropology of Science, Technology, and Computers conference in Los Angeles (Summer 2001). I thank the participants of these forums for productive discussions of this work. I would also like to thank Jeff Lackney for providing generous commentary on an earlier draft of this paper.

2. Several LAUSD school board members and administrators heralded distance learning as a solution to overcrowded schools.

3. Rensselaer Polytechnic Institute

4. I borrow the term "valence" from Corlann Gee Bush (1997) to account for predictability in technology or space uses. In every context, technologies and spaces are charged differentially for a range of uses and are therefore never neutral in any pure sense.

5. I develop heterogeneous architects from the social construction of technology concept of heterogeneous engineering that accounts for design as an activity that mobilizes multiple forces (social, technical, symbolic) to directed ends (Law 1987).

6. The concepts and worldviews of technological determinism and technological neutrality operate

in tension with each other over the question of agency. With technological determinism, people see technologies as propagating on their own. With technological neutrality, people perceive themselves as in control over the uses of technologies. That many people hold both views simultaneously reveals collective cognitive dissonance with issues of agency and responsibility for the built technological world.

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torin.monahan@unc.edu