An Epistemological and Systems Approach To Digital Technology Integration In the Architectural Curriculum

Mahesh Senagala
The University of Texas at San Antonio, USA

Architectural institutions around the world have been faced with the question of digital technology integration for the last one decade. Numerous attempts have been made by these institutions to utilize and harness the new technology by trial and error methods. Although much has been said and done about the computer as a tool and a medium, there is a great paucity of well-considered and holistic theoretical frameworks that have been successfully applied in architectural curricula. The emergence of digital technology as an environment and as an overarching system has not been a much understood or acknowledged fact. This lack of systemic wisdom, in the digital technology integration process, is always punished by the system.

In this paper, I intend to

• Outline the epistemological, philosophical, pedagogical and operational issues of digital technology integration efforts undertaken at Kansas State University.

• Meditate a systemic and holistic framework of principles, paradigms, proposals and strategies from a systems point of view that could be applied at other educational institutions.

In contradistinction to the analytical, hierarchical and prosthetic approaches frequently adopted by the architectural institutions, I propose a systems approach and an ecological paradigm to understand and comprehensively integrate digital technology with architectural curricula. While many of the ideas brought under the framework may not be new, the framework itself is a new proposition. The framework draws heavily from Jean-François Lyotard’s postmodern pedagogical work, Deleuze and Guattari’s post-structural notions of ‘rhizome’, and Gregory Bateson’s expositions of ecological and systems approach.
Prologue

Lack of systemic wisdom is always punished . . . Call the systemic forces 'God' if you will.

-Gregory Bateson

The systems approach distinguishes itself from the more conventional analytic approach by emphasizing the interactions, interrelationships, and connectedness of the different components of a system, considered as a whole in relationship to the system's environment. Systems theory focuses on the components of a system only to look for the general principles and larger connections to the component's environment that are embodied in that component. Ecology is a branch of human thought, for instance, that is based on systems approach. Ecology, in its broadest sense, studies animate or inanimate things in relationship to each other and to their environment as a whole.

As a profession and as a discipline, architecture is at a crossroads in the digital age. Academic institutions have been faced with the question of how to integrate digital technology into their curricula and pedagogy. For the last decade or so there have been numerous efforts by numerous institutions to address the pedagogical, operational, logistical and philosophical questions of digital technology integration.

Our usual approach to the integration of the computers into the architectural curriculum has been to “integrate the computers into the curriculum or classroom.” However such an approach does not reflect a proper understanding of the computer as a new environment. The computer is not just a tool anymore. Rather than integrating the computer into the curriculum, as I will illustrate later, we should let the digital environment integrate disparate elements within the curriculum and beyond the curriculum that have so far remained isolated. We should use the computers to forge new connections with the larger world.

In this context, I would like to propose a series of models, approaches and strategies that would help architectural academia address digital technology integration. These are the lessons learned from the “digital technology integration initiative” at Kansas State University where I had the opportunity to lead the initiative.

Theoretical foundations

From a systems perspective, it is important to understand any phenomenon in terms of its relationship to the larger environment. Such an approach requires that we engage institutional, cultural, pedagogical and professional issues that affect larger systems.

I will begin by briefly identifying what I mean by technology and then move on to a discussion of the post-modern epistemological ideas of Jean-Francois Lyotard and the post-structural work of Gilles Deleuze and Felix Guattari. I will then discuss the principles and models, which we had adopted in the digital technology integration process at Kansas State University.

The meaning of technology

I use the notion of “technology” in the phenomenological way that Martin Heidegger uses. He says: “Technology is . . . no mere means. Technology is a way of revealing. If we give heed to this, then another whole realm for the essence of technology will open itself to us.” Technology is an integral part of being human and is entwined with the human condition, its existence and evolution. Technology is, first and foremost, epistemological—a form of knowledge as well as a way of knowing the world. Further, Heidegger points out that, “from earliest times until Plato the word technē is linked with the word episteme. Both words are names for knowing in the widest sense.” So, when I speak of technology, I am addressing more than a mere manifestation of technology in the form of the machine. As Jacques Ellul says, “as long as technique was represented exclusively by the machine, it was possible to speak of man and the machine. The machine remained an external object, and man . . . was in a position to assert himself apart from the machine. But when technique enters into every area of life, including the human, it ceases to be external to man and becomes his very substance.”

Every mutation in technological knowledge reframes the existing worldview and subjectivity in the co-
text of the new possibilities.

Tools are distinct from environments

Nicholas Negroponte wrote much in the vein of Elihu's observations that "computing is not about computers anymore. It is about living." I think that is a very insightful observation. Negroponte recognized that our societies have made a cultural leap by adapting the computational tools to build an overarching digital culture and environment. Often times, we hear confused and confusing notions that are a result of our failure to distinguish tools from environments. A tool performs a specific task. A hammer or a wrench or a T-square or a CAAD software or a word-processing software are examples of such tools. An environment defines a space of possibilities. A clock is a tool but the cultural notion of "time" is an environment. Our biosphere is a good example for an environment. An environment is a systemic conglomeration of tools, animate and inanimate things, resources, knowledge bases, and a host of other elements, which are in a mutual relationship.

A typical automobile today uses nearly 12-15 dedicated computers. Microwave ovens, telephones, VCRs, pacemakers, wrist watches, copiers, and just about everything around us is infused with microprocessors. The extent of computerization has become so transparent that we do not even realize their presence anymore. What we normally recognize as the computer—the big box with a monitor and keyboard—is just one aspect of the digital environment we live in today. The computer has transcended being an isolated box and has become a part of a gigantic network or networks. This realization is extremely important when we address the issues of integration. We integrate elements into environments and not vice versa. The computer is not one thing, it is many things and it is a part of a larger digital environmental system. While it is important to integrate a tool into our tasks, it is also important to integrate our tasks into our environment.

Paradigm 1: ecology of knowledge

Jean-François Lyotard’s The Postmodern Condition: A Report on Knowledge is a seminal work on the status of knowledge in the computerized societies. Lyotard produced his report on the request of Conseil des Universités of the Government of Quebec. Lyotard writes: “Our working hypothesis is that the status of knowledge is altered as societies enter what is known as the postindustrial age and cultures enter what is known as the postmodern age.” He argues that in the last fifty years, sciences and technologies have been concerned mainly with language and epistemological strategies; theories of linguistics, problems of communication and cybernetics, computers and their languages, problems of information storage, etc.

Another dimension of Lyotard’s argument has to do with the problem of fragmentation and “delegitimization” of knowledge (Figure 1). In traditional societies, legitimation of cultural, social, political and technological spheres was bestowed by what he calls “grand narratives” and the power structures built around those grand narratives such as the Holy Bible for the Christian world and Mahabharata and Ramayana for the Hindu world. In the past two centuries, science and scientific modes of thinking have become discourse of legitimacy in themselves and have been struggling to usurp the central position once held by the grand narratives of various societies. The result, Lyotard
An Epistemological and Systems Approach To Digital Technology Integration In the Architectural Curriculum

Mahesh Senaga

Figure 2.

points out, is that we now have two distinct realms of knowledge. One is scientific or technical knowledge (of which, the machine is a product) and the other is narrative knowledge (myths, legends, stories, theories, etc.). The problem is that scientific/technical knowledge does not represent the totality of human knowledge and thus cannot offer total legitimacy to the way we live and the way we understand our world. "Lamenting the loss of meaning in postmodernity boils down to mourning the fact that knowledge is no longer principally narrative." 8

Lyotard’s exposition is ultimately geared toward understanding the impact of epistemological issues on pedagogical realities. He notes: "If we accept the notion that there is an established body of knowledge, the question of its transmission, from a pragmatic point of view, can be subdivided into a series of questions: Who transmits? What is transmitted? To whom? Through what medium? In what form? With what effect? A university policy is formed by a coherent set of answers to these questions." 9

Lyotard’s model of knowledge in the postindustrial societies offers a good structure for an architectural pedagogy (Figure 2). This is precisely because architectural education needs to bring together technical and liberal knowledge into a creative relationship. Another important concern that Lyotard raises is that technical and technological issues cannot be addressed in isolation from the narrative, philosophical, and pedagogical issues. Thus, Lyotard’s observations lead us to the conclusion that the epistemological components of technical and narrative issues are part of a large system - an epistemological ecosystem.

The importance of Lyotard’s observations is that when we talk about technology integration, we have to talk about the comprehensive ecology of technological knowledge and narrative knowledge.

Paradigm 2: The rhizome - an emerging ecological paradigm

Understanding the impact of technology involves studying its relationship to us and to our institutional structures. Gilles Deleuze and Felix Guattari have provided us with well-articulated metaphors that help us give a structure to such a changing environment around us. D&G’s rhizome is a potent and radical narrative model that could contribute very effectively to the development of a more appropriate and flexible architectural curriculum in the context of the new technological possibilities.

Rhizome is a fascinating notion that D&G propose in their brilliant work “A Thousand Plateaus: Capitalism and Schizophrenia.” 10 As Martin Pearce and Maggie Toy observe, “Gilles Deleuze and Felix Guattari proposed a condition where the top root of ideology has been aborted in favor of the shifting layers and boundless interconnectivities of the rhizome... the model provides a useful analogue to architectural education today.” 11

D&G base their proposition of rhizome on the following principles:

• Principles of connection and heterogeneity (Figure 3). D&G write: “A rhizome ceaselessly establishes connections between semiotic chains, organizations of power, and circumstances relative to the arts, sciences, and social struggles.” 12 Further, they write: “any point of a
rhizome can be connected to anything other... This is very different from the tree or root, which plots a point, fixes an order. Ecosystems are rhizomatic in nature. All higher-order intelligent systems are rhizomatic. Brain, for instance, is a rhizomatic system. Digital technology has the potential to take us closer to becoming rhizomatic in political, social, economic and educational systems.

- Principle of multiplicity (Figure 4): A rhizome cannot be treated as a unity; it could only be a multiplicity. Unity would signify a coming together of a number of singular identities with a certain hierarchical order. D&G observe that the concept of unity appears only when there is a takeover of the multiplicity by one dominant element or idea that establishes a subject/object duality. A house of cards is a system where every point depends on every other point to maintain its unity, but every point is not connected to every other point without dependence. So, if you remove any single connection everything else falls down. All that is united must fall apart. All that is united maintains its integrity by top-down hierarchical strategies. Now, think of the way we normally conduct the design studios: The design studios are treated as self-contained units with a clear beginning, middle and a clear conclusion. The student is thought of as a neophyte who needs to be imparted "training" and "learning" so that he or she might become "one of us" - the wise trees. The flows of the conventional studios have clear-cut hierarchies and orders. You disrupt one flow and that severely affects the functionality of the rest. Digital technology, as I will illustrate later, has the potential to enable multiplicious curricula.

- Principle of signifying rupture (Figure 5): A rhizome may be shattered into multiple pieces, but it always grows again from those pieces, thus resisting any singular signification. If a rhizome is ruptured at any point into two pieces, the two pieces would grow along the lines of rupture and regenerate themselves. The rupture and the number of ruptures do not signify anything in particular. In contrast, if a square is cut diagonally, it breaks down to two triangles. Our educational system works with "quantification" of training and education imparted through well-
quantified and numbered courses. If you take away one course and one quantity from that system, everything else disintegrates. Through new technologies, we could develop educational systems that are more rhizomatic.

- Principle of cartography and decaclamania: A cartographic map is a rhizome in the sense that different points on the map form connections with different points of a terrain without a particular beginning or end. A map forms a rhizome with the terrain. In distinction, a tracing (decal) merely establishes a singular reproductive connection with the original—a copy. I think that this principle is quite important to architectural education in the sense that certain curricula and certain design studios are modeled as imitations or reproductions of the professional architectural setup of the so-called "real world." The problem with such a model is that it reduces the studio to a mock-up and it becomes a tracing of the profession.

The notion of 'rhizome' and its principles have significant application in the process of rethinking about architectural curricula while integrating digital technology.

**Approach: genetic integration or prosthetic addition?**

Commenting on how science today has become a mere bag of tricks as opposed to a systemic understanding of the world, Gregory Bateson notes that we often tend to choose short-term prosthetic approaches to deal with our problems. As a profession, our approach to addressing the issue of digital technology has been at best prosthetic and compartmental. Instead of addressing the systemic, epistemological and philosophical issues of architectural pedagogy and digital media, we often overtly focus on and isolate their technical and operational issues. As I will discuss later, such emphasis coupled with hype results in a single-species exclusive media system that is heavily lopsided.

Prior to the digital technology integration process, our institution had an elective course where the students could choose to learn the use of digital tools. Also, the institution had a "digital design studio" where the students could bring their computer into the studio (Figure 6). These "prosthetic" strategies did more harm than good to the understanding and integration of digital media. The digital tools became at once both exclusive and elitist. The use of these tools remained largely outside the central pedagogical and curricular framework of the institution.

The student body began polarizing itself into CAAD-proficient or CAAD-deficient persons. The majority of the faculty at our institution approached the digital tools and studios with either a distant scorn or a curious suspicion. Everything in the curriculum had remained unaffected except for the prosthetic addition of the so-called CAAD course and the "Digital Design Studio."

We do not conduct watercolor design studios, charcoal design studios, cardboard design studios and so on. But we do conduct single-media digital design studios! While we may emphasize one medium or the other, the studios should normally remain focused on the design project and architectural discourse. At that point, we had realized that the prosthetic addition of a Digital Design Studio was neither pedagogically nor philosophically sound beyond its limited experimental value.

As an alternative, we had eliminated the notion of exclusive "digital design studios" and begun thinking about infusing the otherwise encapsu-
lated knowledge of digital media in a more generic fashion into the curriculum. True integration comprehensively transforms an entire system. This principle led us to the development of the following two strategies.

**Strategies: literacy and expertise, grassroots and taproots**

We had adapted these epistemological, pedagogical and operational strategies to accomplish a number of objectives. These strategies helped us devise a set of courses that were aimed at achieving horizontal digital literacy during 2nd and 3rd years of the five-year architecture program. We then devised vertical courses that were aimed at those students who wanted to take their skills and knowledge further. Literacy courses were required and core courses. Whereas, expertise courses were electives. These courses were aptly framed by a seminar and theory course that dealt with the narrative issues of digital technology. The strategy of literacy and expertise was extended to faculty development through a series of workshops and virtual forums.

Another way this strategy helped us was in addressing the resource development issues. The resource development was divided into these two categories where the acquisition and maintenance of basic tools and environments were relegated to the students. The purchase and maintenance of high-end workstations, network environments and specialized input and output equipment were relegated to the institution. Thus, like at many institutions around the country, the students were required to bring into the classrooms and studios their own network-ready computers in addition to their text books and backpacks. This move yielded a number of useful results. On one hand, we had the problem of computer obsolescence resolved as every fresh batch of students would bring the most current technology available in the market. This move relieved the institution of the burden of providing basic computer literacy and coping with the rapid obsolescence of large number of computers. Thus, the literacy-expertise strategy enabled the institution to focus on providing the network infrastructure, input and output devices, high-end workstations and other expensive provisions to complement the basic student computers.

This strategy had also yielded an unexpected and serendipitous result. The learning had accelerated by leaps and bounds due to the fraternization of the student learning process. The students began to help each other at a grassroots level. At that point, we had developed a variety of support structures to complement the grassroots flow of knowledge with a toproot support system. A system of teaching assistants was utilized not only to address course-specific questions but also the application of knowledge in other courses.

**Approach: media ecology in the studio system**

As Gregory Bateson has once pointed out, human beings tend to create single-species ecosystems and support systems: "Man, the outstanding modifier of environment, similarly achieves single-species ecosystems in his cities, but he goes one step further, establishing special environments for his symbionts. These, likewise, become single-species ecosystems: fields of corn, cultures of bacteria..." The same tendency is reflected in the context of design curricula and pedagogy. Often we encourage or impose one tool and one ideology at the expense of other tools and other ideologies. Ecological thinking could come to our rescue here.

Some of the most frequent issues raised in relation to digital media in design curricula are: how do we integrate the digital media into the curriculum? Do we replace the traditional media? Do we replace pencil and paper in lieu of the computers? What is preferable: the digital tools or the traditional tools? Soon we had realized that as long as we were asking wrong set of questions and addressing various media as isolated and exclusive elements, we would get nowhere. Instead, we had adapted an ecological and epistemological approach. This approach helped us address the design media, the students, knowledge, skills, curriculum, faculty expertise, and a host of other elements in
terms of their interrelationships. Specific strategies that we had initiated are illustrated below.

**Strategies: physical to virtual; concrete to abstract; forming media rhizomes**

As we have recognized from the phenomenological notion of technology and from Latour's model of knowledge that all media are forms and manifestations of technology, and that technological knowledge is incomplete without a healthy relationship to narrative forms of knowledge (Figure 7). Watercolor is technology. Pastels are technology. Pencil and drawing are also products of technological thought. We forget that it is only in comparison that digital media "appear" to be more technological than a pencil. All techniques and technological knowledge needs to be brought into a meaningful relationship to the narratives of the discipline.

The question then became, how could a set of tools enhance and relate to the other tools in the ecosystem of design media? The issue then shifted from "what is a certain medium" to "how does this medium relate to other media?" How could we take a water color sketch and transform it into an exquisite 3D digital model? How could we take a 3D digital model and transform that into a charcoal sketch? Many such questions of relationship were posed. As a result, a diversity of media was encouraged in the design studios and related courses. We had also promoted a rhizomatic ecology of various media. We did so by not establishing any preferences or hierarchies between those media. The diversity, coupled with the flexibility of use of media helped the students and the faculty not only make the best use of each media but also to understand the inherent strengths and limitations of each media in the design process. Various media could form a media-rhizome. Every media could be transformed into and connected to every other media in the process of the creative integration of various forms of
knowledge to ultimately inform the design process at hand.

These efforts were akin to the explorations conducted by numerous others[16]. Shown here are some examples from author's own work (Figures 8 and 9).

Approach: integration and curricular ecology, some proposals for the future

Tools and environments are distinct ends of a system and need to be addressed and used at different levels of the integration discourse. As I had mentioned earlier, in addition to integrating media into the pedagogical and curricular structures, we must begin to think about how to integrate different parts of the curriculum that have remained isolated so far. As all the educators know very well, one of the concerns with the traditional curricular structures has been “how do we bring together the technical and narrative forms of knowledge of structural systems, building construction systems, history, theory, and also on into the design studios?” Another concern has been “how do we bridge the gap between architecture and other allied disciplines?” We began considering the notion that various courses and curricula in the university actually form a curricular and pedagogical ecosystem. Every course should therefore be considered in relation to the larger curricular and epistemological ecology.

The computer is more empowering to us as architects and human beings as an environment that integrates rather than as a tool. We could use the approach of curricular and pedagogical ecology in order to address the long-standing concerns. This approach could be implemented through the following strategies.

Strategy: wall-less studios[17]

Here we need to make a clear distinction between the notion of wall-less studios and some experiments carried out at Columbia University, MIT and elsewhere. These paperless studios, electronic design studios and virtual design studies are significant strides toward coming to grips with the changing environment and context of architectural education. However, those experiments also portray how difficult it is to break free from the bounds of the past models of studios and to find out theoretical and philosophical narratives and metaphors to advance new pedagogical models. For instance, paperless studios are centered on a pedagogical discourse about the use of the medium of design within the studio boundaries. Such a studio may question the traditional media of design but not necessarily the traditional pedagogical modes of conducting a design studio. The framework of those studios is defined and maintained by the instructors and students with the discourse contained within the walls of the studio. I myself have encountered such difficulties and therefore can understand the struggle for innovation. These difficulties remind me of the early days of cinema when people could not escape the theatrical modes of presenting a story. The real revolution in cinema occurred when people realized how time and space could be edited, cut, spliced and montaged at will.

In contradistinction, a wall-less studio is not necessarily about digital technology albeit its lifetime is digital technology. A wall-less studio is NOT a digital design studio.

A wall-less studio is a rhizome. It is a concept that ventures beyond the metaphorical walls of the studio and strives to establish rhizomatic connections with the profession, other disciplines, people, resources and knowledge from around the world, and aims to let those connections profoundly influence the process and workings of the design studio. Wall-less studio is about establishing connections between people, knowledge, machines, resources, and discourses both inside and outside the studio walls as opposed to the traditional modes of conducting a studio, namely “training” and “problem solving.”

In a wall-less studio, the discourse of the studio crosses the boundaries of the studio. It is not a simulation of the “outside world” or “real world,” but makes significant connections with the “larger world” by eliminating the “outside-inside” and “real-simulated” dualities of the traditional peda-
An Epistemological and Systems Approach To Digital Technology Integration In the Architectural Curriculum

Mahesh Senagala

...logical models. A wall-less studio is about breaking the barriers of disciplines and cultures through the use of technology.

A wall-less studio is more a political and pedagogical move than a technological move. Thus, a wall-less studio seeks to achieve a real integration of people, students, teachers, resources, cultures and discourses.

In a wall-less studio, there would be no four-way division between the instructor, the student, the student's work and the so-called "real world." The work produced in the studio is not a simulation of the "real thing." Neither is the instructor the command-in-chief of the studio, nor is a student a half-baked professional striving for perfection. Instead, the work, the students, the instructor and the world (the entire world: peoples, cultures, professionals, resources, texts, things, relationships, memories ...) form a rhizome. Together, the quartet forms a rhizome and grows beyond the "walls" of the studio.

Epilogue

Often times, it takes a paradigmatic shift to deal with new technological and cultural developments. Old paradigms and methods need to be constantly reconsidered and revised. Digital technology, as represented by the computers, has transcended the status of a tool and has become an all-encompassing environment within which our society functions. The conventional models of understanding the world are slowly giving way to systems thinking and ecological models. Tree-like structures are giving way to rhizomatic structures. Digital environments are making the rhizomatic relationships (that are ecological and natural) a great possibility.

The ecological models could also be extended beyond the limited scope of things discussed in this paper. Such notions as "ecology of ideas", "ecology of cultures" and so on could be explored for ways to foster healthy learning and working environments.

The conventional "either-or" hierarchical modes of thinking about architectural curricula need to recognize the value of rhizomatic and ecological modes of thinking from a systems point of view. Ecological paradigms could help us bring disparate and diverse elements as well as media into a rhizomatic relationship to the world. Such a world would be inclusive, flexible, rich and more meaningful.

Notes:

4. Ibid. (p. 13).
9. Ibid. p. 3.
10. Deleuze and Guattari build upon Gregory Bateson's ideas of "Plateau". They write: "A plateau is always in the middle, not at the beginning or the end. A rhizome is made of plateaus. Bateson used the word "plateau" to designate something very special: a continuous, self-vibrating region of intensities whose development avoids any orientation toward a culmination point or external end." Gilles Deleuze and Felix Guattari (1994). A Thousand Plateaus: Capitalism and Schizophrenia. Minneapolis: University of Minnesota Press.

13. Ibid.


17. The ideas of Wall-less Studios and Rhizomatic Pedagogy have been explored in greater detail elsewhere. See Mahesh Senagala (1999), Toward Noosphere: Envisioning Wall-less Studios and Rhizomatic Pedagogy, Geraldine Forbes Isals & Marvin Malecha (Eds.), ACSA Annual Meeting Proceedings, Minneapolis: ACSA.