Repositioning the Essential Art in Collaborative Technology-Mediated Design Education

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Asserting the responsiveness of integrated design processes to the human condition relies upon these processes being informed by an artistic tradition founded in cognitive activities that are motivated by the conceiving of unique environmental form. This paper examines the changing, yet essential role of creative activities in contemporary project delivery systems within the context of an ideal business construct, the Virtual Organization. The implications of this transformation for project-based design studio synthetic experience-contingent learning are discussed with reference to an ideal pedagogical construct, the Virtual Design Studio. Because the latter represents learning experiences that are predicated on its empirical counterpart, the Virtual Organization, pedagogical dimensions appropriate to learning strategies in collaborative technology-mediated environments are explicated.

Transformations in the professional practice of providing architectural services can be traced to early beginnings in ancient Egypt and Greece. Throughout the history of the profession, much like today, these transformations reflected the profession's response to changing and increasingly complex societal demands for environments that are rooted in individual and collective human experiences. To strategically address these societal demands within programmatic parameters, increased specialization in practice in collaboration with other industry specialists was necessary. As a result, today many design business entities are evolving toward some form of a transdisciplinary operational format that may be characterized as a multi-level coordination of specialized disciplines essential to the delivery of specific projects. One unique aspect of professional practice, however, remains virtually unaffected by the dynamics of present market fundamentals, and that is the design activity that draws from an artistic tradition. This is evidenced by the profession's objectivist epistemology that has been consistently articulated through classifiable building types appropriate to historical styles and movements. Although the diversity of the contexts of contemporary professional practice increasingly challenges models of expertise predicated on this tradition, an analysis of trends in design education indicate that much of the academic theory of

design rooted in this artistic tradition will remain basic to even new paradigms that incorporate information age technologies in design studio-based pedagogy.

In this context of analysis two significant observations emerge, both of which reflect concern for the structuring of project-based design studio education models as mediators of dilemmas inherent in the balancing of the design professions' legacies with their aspirations. First, there is a general consensus that the information revolution and virtual technologies are redefining the assumptions that are foundational to the human experience, to which design as a transdisciplinary process is integral. Second, the act of conceiving the built environment is considered a fine art that can creatively intervene in this process on behalf of humanity, even if it operates within the referential framework of industrial and mechanistic technologies.[1]

Both of these observations converge on the single, but multifaceted empirical fact, that professional design education is seated in a particular realm of a constant state of flux, fueled by tensions of interplay between conservative assumptions rooted in the tradition of fine arts and contemporary priorities generated by changing market place demands. This disposition mandates tradition-resonant pedagogical responses to changes in professional practice paradigms in the form of continued realignments of education models to emerging practice models. Fundamental to this dialogue between the practitioners and educators is the ongoing reexamination of models derived from direct empirical observation of the dynamics of the contexts of professional practice and of the competitive market driven responses initiated by practitioners.

A comprehensive approach to formulating such pedagogical responses requires multiple levels of analytical inquiry. On the pragmatic levels, compliance with program accreditation guidelines and curricular cognizance of state licensing criteria can ensure an interface between education and practice. Curricular mission and goals can provide for the evolution of a program's identity that differentiates it from other educational programs. It is on the conceptual levels, however, where knowledge building and the development of theory occur in studio-based education, and where the discipline's legacies and aspirations are consequentially mediated. This process of mediation requires pedagogical strategies that are informed by models of contemporary project delivery methods and are based on some aspect of learning theory.

The Design Process in Contemporary Models of Project Delivery Systems

A universal perception of architectural design is what architecture is all about. The skills and knowledge unique to the creative design process constitute what differentiates architects from any other professionals. However, the context in which the talent of utilizing these skills and knowledge occurs is ultimately decided by society. Thus, designs are no longer created but evolved through the occupancy phase of project delivery. It also follows, therefore, that construction documents no longer serve as representations of design problem-solutions, but rather as illustrations, in the form of legal documents, of design intentions whose continuous change throughout the implementation of the design is strategically managed. As a result, linear design-bid-build approaches, by necessity, have given way to a dynamic synthesis of mutually contingent design, management, and implementation techniques at various levels of decision making within various contractual relationships, which comprise today's project delivery procedures. A comparison of a chess game to an interactive video game illustrates the inherently different characteristics of these two methodological paradigms.

These developments are reflective of and congruent with the present day forms of global business organizations in which corporate strategic management skills and knowledge, rather than capital, equipment, and personnel constitute the key business resources.[2] Although these business operational formats de-emphasize the individualistic and traditional approach to project development, they do provide for the integration of artistic, innovative, technical, and financial professionalism of individual team members. This process, however, continuously redefines creativity in terms of individual project participants' abilities to integrate a given concept, whether artistic or financial, into a col-

lective effort by effectively intervening in the project delivery process. Thus, the essential art in design lies not only in the creative process, but most importantly in how the products of this process are positioned in the strategic goal structure of a project delivery system. Within these settings the emphasis is on the value of collaborative efforts that manifest in strategic organizational capabilities, which produce a competitive advantage in a market environment where creative talent alone rarely produces the same. Such synergies are fundamental to the managed control of project quality, economy, and schedule. Although they underscore the viability of providing professional services with a focus on a building's function and the client's business strategies, issues of aesthetics often appear subordinated to the latter.[3]

It is abundantly clear at any level of analysis, that design implementation strategies are implicated in the complex of consumer-design-production processes. The most significant aspect of this method of project delivery, is that the programming, design, preconstruction management, and construction functions of project delivery processes perform as an integrated system, and any dissonance among these components due to changes will affect each of the other components, and alter the whole. Any so-called open system as described by von Bertalanffy, i.e., systems maintaining themselves in a continuous exchange of information with their contexts, must take into account that changes in project parameters are inevitable.[4] In order to maintain program continuity and design integrity throughout the delivery process, these changes require managed control. This is an acknowledgment, therefore, that within the larger context of the building industry a strategic management approach to project delivery is the essence of design implementation; all other activities, ranging from programming through construction, ultimately are consequences of this basic fact. When the interrelatedness of actions that underlie the foundation of these approaches is not acknowledged by design professionals because of their reliance on some form of design-bid-build method of project delivery, problems arise.

While recognizing the beliefs, attitudes, systems of thought, and the idea of the creative genius (superego, Nietzchean Superman) that shaped the evolution of the profession of architecture, Steen Eiler Rasmussen reflects on the art in architecture, as well as the social obligations that are integral to the pursuits of creative activities,

> ...the best buildings have been produced when the architect has been inspired by something in the problem, which will give the building a distinctive stamp. Such buildings are created in a special spirit to others. [The building's] features become a means of communicating feelings and moods from one person to another.[5]
>
> Architecture is a very special functional art; it confines space so we can dwell in it, creates the framework around our lives. In other words, the difference between sculpture and architecture is not that the former is concerned with more organic forms, the latter with more abstract. Even the most abstract piece of sculpture, limited to purely geometric shapes, does not become architecture. It lacks a decisive factor: utility.5

Reconstructing the Essential Art in the Virtual Organization

The essentialist position with respect to art in the design process rests simply on the empirically verifiable fact that the appeal of the built environment is predicated on elicited responses of the human perceptual systems, emotions, and the intellect, rather than its resonance of the priorities of its political and economic contexts. Thus, its social impact renders it a cultural artifact, much like painting or sculpture. The support for this position, however, can only derive from effective participation in the strategically managed control of

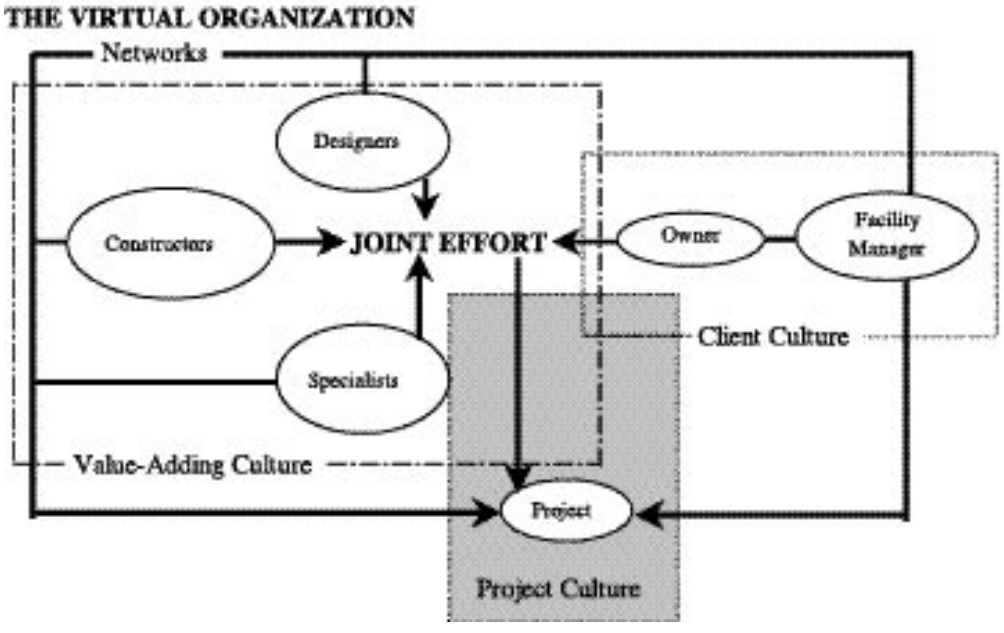


Figure 1a.
The Virtual Organization is a collaboration among various business entities that are parties to a specific method of project design, development and delivery by providing intellectual and physical resources within operational formats for the exchange of project relevant resources. It is founded on proactive systems of thinking about design, theory, and ideology, which are fundamental to emerging formats of professional practice. It may be an organization or company whose members may be geographically apart collaborating by groupware (electronic collaborative technologies)[6] while performing as a single and unified organization.[19]

dynamic processes that are centered on the development, design, and delivery systems of projects that operate in macroeconomic contexts. A conceptual model of such project delivery processes is the Virtual Organization in Figure 1a as conceived by Scott MacLeod. In this model creative design is represented not as independent task for which all responsibility is assumed by the design professional, but rather as a process that permeates the delivery system and extends into the post-occupancy phase.[6] The success of collaborative ventures modeled on this approach is already being evidenced by high profile projects where individual architects or small specialized design business entities reputed for their aesthetic signatures collaborate with several other business entities within a strategically managed delivery system.

The project delivery system represented as a Virtual Organization modeled in Figure 1a describes the interactive and interdependent networked cultures that sustain a resulting Project Culture. Each culture is formed by participants as they shift their focus from the achievement of internal corporate goals to the continuous alignment of incentives with project goals. The sharing of organizational resources, expertise and information eliminates duplication of efforts and assures the effectiveness and viability of each of the cultures. Most importantly, such operational formats are highly adaptable to any setting intended to provide optimal performance to owners/clients through the evolutionary process of strategic decisions with respect to the exploitation of opportunities and resources.

Drawing on the theoretical works of von Bertalanffy in general system theory, the Virtual Organization may be viewed as a system within the larger socio-economic context where it functions inside the boundaries of an intra-dependent activity network.4 Continuous exchange occurs not only among entities within the Virtual Organization and the building industry, but with society as a whole, which is a participant in every exchange transaction. In this sense, a designer's creative activity is not only a function of one individual, it is also a function of society. Any designed and subsequently built product, therefore, is the consequence of evolving exchange transactions in the form of strategically managed implementation procedures, and is representative of a mutually rewarding relationship between an architect and consumer with the support of change agents in a capitalist political economic con-

text.

The key to this relationship is the Value-adding Culture component of the organization, which is driven by design in an environment that expedites the facilitation of implementations of alternative project decisions. This is important because there is minimized dependence on legal instruments, which spell out the guidelines for performance of all contracting parties. Paradoxically, such documents allow for exposure to risk that there will be unresolved conflicts during project delivery that cause changes in design, schedule, and cost parameters. These risks mostly associated with design-bid-build project delivery approaches, for example, are inevitable because legal instruments cannot engender working relationships among contracting parties during project delivery and cannot ensure the optimum performance of contractual agreements. Therefore, detrimental reliances among parties can, and do develop, especially when there is physical separation between the contractual agreement on the one hand, and the construction documents on the other.

In contrast, Virtual Organization models provide for the generation of alternative courses of actions, which are responsive to constantly evolving project delivery conditions that affect design. Central to their inherent flexibility is an 'approach' that represents differing constructs, i.e., complexes of relationships. These models are pluralistic and circumstantial to specific projects, thus lending themselves to comprising neither a single system theory, nor a simple method in the highly interactive present day building industry, where architects are

> drawn into a kaleidoscope of arrangements with other practitioners, contractors, project managers, and allied professionals to produce client services. These many permutations, each with its own set of contractual relationships, form a complex array of project-delivery systems.[7]

A significant feature of these practice models is that in the project delivery process they focus on the mutual interdependency of pro-active decisions that are inherent in the transactional character of the building industry, where strategic management is the primary mediating process. They produce consonance across the boundaries of specializations, which by interaction comprise the total project delivery process. On this view, there can be no excessive emphasis on any singular function within an area of specialization, such as programming, design development, or even construction. It is unlikely, therefore, that any one of these functions is perceived or pursued independently in order to avoid its reduction to a philosophical, creative, technical, or experimental abstraction apart from the interactive total project delivery system.

Repositioning the Essential Art in the Virtual Design Studio

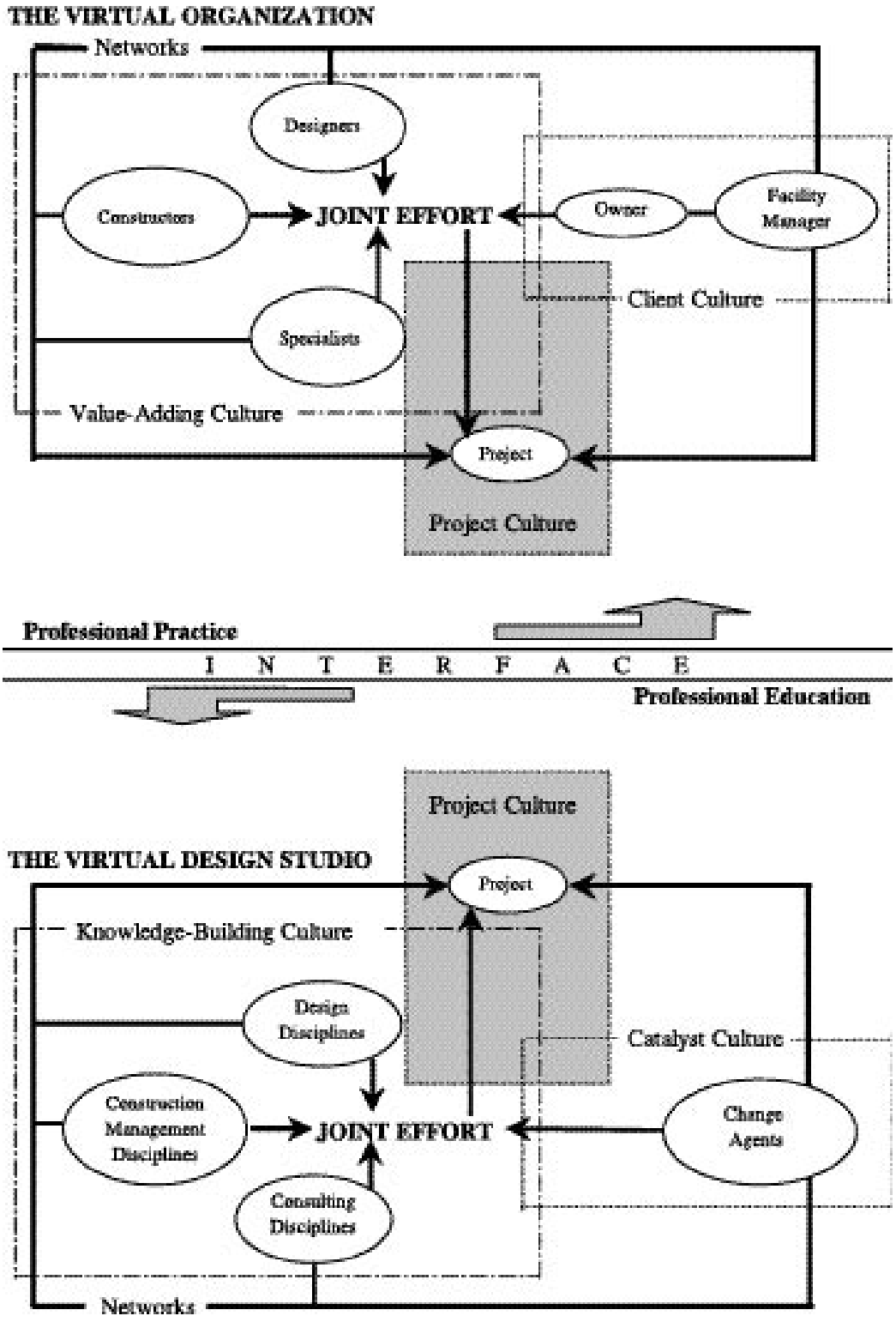
In a call for papers by the Walter Wagner Education Forum to be debated at the 1994 Association of Collegiate Schools of Architecture Annual Meeting in Montreal, Canada, two perceptive questions were posed: 'Does the entrepreneurial spirit offer both architectural firms as well as architecture schools a new range of opportunities in a radically changing business environment? Or is it a dangerous threat to the professionalism of architecture?'. Given the preceding analysis of the current state of developments regarding the contexts of the professional practice of providing architectural services, an informed response to the former question may well be that it consistently provides architects unprecedented opportunities to reconstruct and reposition the essential art in architecture to enhance its responsiveness to the contemporary issues that define the human condition. But most importantly, it affords educators opportunities to proactively redefine key curricular concepts to engage in the development and implementation of informed design pedagogy, which acknowledges the transformations in progress that are driven by the dynamics of the projected business environment. The latter question may elicit some contemplation and an affirmative response only when the concept of professionalism is confined to the realm of the

> idea of the "creative genius" (superego, Nietzchean Superman) which remains a potent ideology in architectural myth-making and one which has been identified with many problems that face architecture.[8]

Figure 1a.
The Virtual Organization is a collaboration among various business entities that are parties to a specific method of project design, development and delivery by providing intellectual and physical resources within operational formats for the exchange of project relevant resources. It is founded on proactive systems of thinking about design, theory, and ideology, which are fundamental to emerging formats of professional practice. It may be an organization or company whose members may be geographically apart collaborating by groupware[19] (electronic collaborative technologies) while performing as a single and unified organization. [6]

Figure 1.
Model of the corresponding relationship between the Virtual Organization grounded in a capitalist political economy and the Virtual Design Studio grounded in cognitive learning theory that is applied to the simulation of the dynamics of the former to create a context for 'anchored instruction'. The essential art in design is inherently positioned in the corporate Value-Adding Culture and in its corresponding educational counterpart, the Knowledge-building Culture. Both cultures strategically ensure supportive Networks-informed operational frameworks for the development and experimental analysis of alternative design responses to evolving programmatic parameters delineated by either the real or simulated Client Culture.

Figure 1b.
The Virtual Design Studio represents and describes collaboration among disciplines within an educational institution or with other institutions also working by groupware, unified by joint efforts in simulated or real project delivery scenarios. Collaborative efforts are structured to provide and utilize instructional and technological resources within formats created for
the exchange of information and ideas among educators, students and practitioners with project-specific expertise.



Upon further reflection, however, both questions probe the complex issue of how educators are to develop education models that can eventually provide the substance for successful practice models. The complexity of this issue is compounded by the diversity of perceptions and interpretations of the business environment, where changes are so unexpected and constant as to make expectations by educators about the dynamics of practice models sometimes inaccurate. This is especially true of those practice models that systematically generate profits from opportunities created by the changing marketplace and appear to be most integral to fundamental changes taking place in the profession.

This issue, however complex, can be addressed in the development of education models that not only integrate the creative activity component of design, but also sustain its powerful traditional role in project delivery processes simulated in the Virtual Design Studio. This can be achieved, as shown in Figure 1, by defining corresponding relationships between models of professional practice and professional education by ways of aligning the latter to transformative trends in practice that are congruent with the quintessential aspects of the Virtual Organization. The Virtual Design Studio model in Figure 1b, derived from and interfaced with the Virtual Organization model in Figure 1a, illustrates such a corresponding descriptive and prescriptive relationship.

The Virtual Design Studio as shown in Figure 1b, an ideal pedagogical construct, represents learning experiences that are predicated on its empirical counterpart, the Virtual Organization shown in Figure 1a. These experiences then are organized around a methodological paradigm that integrates the creative art and building technologies in design, and anticipates transformations in professional practice. Much like its counterpart, the Virtual Organization in which a specific method of project delivery serves as an 'anchor' or focus for joint efforts, the Virtual Design Studio is a problem solving situation that focuses collaborative efforts among educators, students, and practitioners to retrieve and construct knowledge. This requires a holistic approach to learning, where simulated project delivery scenarios provide for the multilevel coordination of diverse student and faculty activities from various relevant disciplines to generate methodological frameworks for integrative building designs. Any scenario that simulates today's project delivery processes can be explicated only in terms of dynamic sets of relationships that impinge on continuously evolving project parameters and goals. Thus, the multi-level coordination of input from various disciplines offers the greatest opportunity for the refinement of judgment skills with respect to the synthesis of numerous conflicting variables throughout the simulated project delivery management process. Higher levels of integration may be achieved with computer systems that have application tools that allow project participants to generate plans, develop design concepts, evaluate alternative solutions, and resolve conflicts as they arise. New generation computers with symbolic and knowledge-based reasoning can provide electronic versions of design concepts and relevant programmatic descriptions of behavioral systems, spatial functions, and the like. The Integrated Building Design Environment (IBDE), a project dedicated to the development of such models for a 'master builder', for example, has hundreds of application tools that can support and enhance learning.[9]

Learning Strategies for Informed and Integrated Creative Endeavors in the Virtual Design Studio

The sheer imponderable complexity of overwhelming design information in contemporary professional practice is the overt premise for the computational environment dependent Virtual Design Studio. Beyond the managed processing of information and the automation of traditional tasks associated with the creative process of design, however, lies a range of creative activities that have the potential to produce new knowledge. These activities, when combined with computational processes, underlie not only analytical inquiry into the various novel domains of artificial intelligence, but also modifications, extensions or transformations of such domains by manipulation of project relevant domain-specific constraints. Igor Aleksander,

a leading exponent of neural networks, reaffirms this symbiotic relationship between information technology and the creative process in his research of the unique capabilities of the human brain. He argues that the brain is extraordinarily good at making guesses based on experience, at retrieving knowledge from memory without the need for exhaustive searches, at perceiving analogies and forming associations between seemingly unrelated items. (He considers these aspects of intuition, perception and imagination the traditional creative engines for architectural ideas.) But he also maintains that prototyping, modeling, testing, evaluation and evolution often require the formidable power of the computer, even if initially sparked by human creativity.[10]

Given this premise and the fact that creative design is a cognitive activity, it is generally believed that the learning theory in psychology affords teaching approaches richness, logic, rigor, and other highly regarded properties. It stands to reason, therefore, that design pedagogy in the Virtual Design Studio incorporates concern for pedagogical dimensions appropriate to computational environment based education predicated on some aspect of learning theory or learning concept that can also serve as a criterion for the evaluation of student performance. Tom Reeves, in a recent study of the effective dimensions of interactive learning systems, views pedagogical dimensions as those aspects of the development and implementation of computational environment dependent education that directly affect learning.[11] The study examines and describes the applications of fourteen such dimensions, of which two are especially relevant to the effectiveness of the Virtual Design Studio, specifically, experiential validity and pedagogical philosophy.

Experiential validity or experiential value, although rooted in the apprenticeship education model and analogous to traditional 'master studio' formats of studio based education, as a pedagogical dimension, remains key to contemporary learning strategies. With reference to the Virtual Design Studio, its benefits become manifest as learning transfers to situations in professional practice. According to Reeves, whose view is supported by the findings of other cognitive theorists[12,13,14]

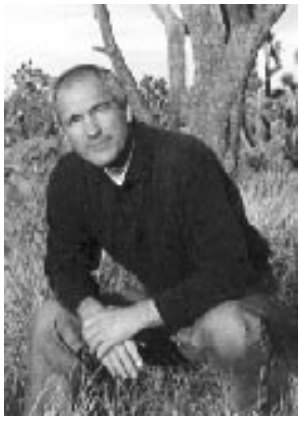
> the way in which knowledge, skills, and attitudes are initially learned plays an important role in the degree to which these abilities can be used in other contexts. To put it simply, if knowledge, skills, and attitudes are learned in a context of use, they will be used in that and similar contexts. This principle is especially important in professional education.[11]

The role of the educator, therefore, is minimally didactic when providing project relevant information, and more facilitative when guiding of students individually or collectively to generate any possible connections among conditions (such as in a design project scenario) and actions (such as the use of knowledge as a tool to constructively intervene in the scenario). Ultimately the educator's role is to structure a design research problem solving situation that serves as an 'anchor', and to focus collaborative efforts among Virtual Design Studio project participants on the constructing of new knowledge and the formulating of design responses to evolving project parameters. Cognitive psychologists at the Cognition and Technology Group at Vanderbilt University (CTGV) call this type of instruction 'anchored instruction' because the process of constructing new knowledge is situated or anchored in meaningful and relevant contexts. They maintain that events and problems presented in this manner can be intrinsically interesting and challenging. They have evidence that in response to conditions such as those that constitute a simulated project delivery scenario, students construct useful as opposed to inert knowledge.[15]

The other pedagogical dimension, pedagogical philosophy, can be described as an orientation that can range from a strict instructivist to a radical constructivist approach to teaching and learning. There are clear distinctions between these approaches and what they can be expected to accomplish in professional education.[16] An instructivist approach, for example, is intended to achieve learning objectives that are independent of learners and are drawn from a domain of knowledge, e.g., building and life-safety codes; or are based on the activities of practitioners, e.g., contract

negotiations. Learners therefore, are primarily the passive recipients of instruction. Alternatively, a constructivist approach may be intended to achieve a state of cognitive equilibrium through the learners' reconstruction of concepts, schema, mental models, and project-relevant cognitive structures when managing the processing of new information and the negotiating of new experiences that may be in conflict with previous constructions. Thus, learners are active and involved participants in the constructions of knowledge. To illustrate, a computer-aided design environment intended primarily for the automation of design related tasks mandates an instructivist biased pedagogical dimension, whereas the Virtual Design Studio, which is an interactive learning environment with microworlds and 'mind tools', mandates that both pedagogical dimensions play strategically essential roles. The instructivist learning approach is to provide for the development of a knowledge base to inform the design process, while the utilization of this knowledge base is to be guided by constructivist learning strategies.

Research findings indicate that only a constructivist pedagogical approach can assure that design activities in a Virtual Design Studio reflect the complete spectrum of views articulated to whatever extent by all of the participants within the three Virtual Design Studio cultures. Constructivist epistemology calls for a multiplicity of perspectives so that project participants have a full range of options from which to construct their own knowledge base for design decisions. This can provide the participants with opportunities to rediscover currently accepted theories of the design disciplines, as well as rival theories that may eventually replace the current positions. This approach might also provide guidance or support to participants in their discoveries, but without being overly directed in the learning process.[17] These views are supported by a growing recognition among learning theorists that there is no 'absolute' knowledge and that there is more than one viable perspective on knowledge.[18] This shared view suggests that knowledge is recognized as being socially and individually constructed on the basis of experience. In the Virtual Design Studio this experience can be significantly enriched and expanded by the affording of opportunities to participants to be pro-active in simulated project development, design, and delivery processes, which are detailed so that their benefits extend to all members of the process management teams. In the procedural course of strategic decisions this is a precondition to any effort directed toward the optimization of processes being managed. Project scenarios, therefore, must be structured so that all participants have information access for decision-making, where decisions are converted into multidisciplinary input, and are integrated with an open-ended approach to interface human and physical resources to achieve project goals within evolving parameters. Individual decisions are to be evaluated in terms of their potential and observed impacts on the process, and are to be systematically monitored and tracked by performance-based assessment of students' ability to process and translate programmatic information into courses of actions. Desirable courses of actions and their outcomes, for example, are to be represented, depending on the phase of the project, in various forms: i.e., cost analysis of design options, alternate structural design solutions, design concept



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Conclusion

Core services, which address the creative definition, organization, and management of the built environment, will remain central to models of professional practice for the foreseeable future. The configuration of these services, however, will continue to undergo transformations induced by the changing contexts of professional practice and advancements in Artificial Intelligence. Both of these will have significant ramifications for the positioning of the essential art in integrated design processes. Contemporaneously, while the development of design skills and related knowledge, which draw from an artistic tradition, remains central to design education models, the structuring of experiences that can transform these skills and knowledge into competitive advantages in unpredictable market economies where art is a cultural capital, will increasingly become a challenge for educators. By structuring the collaborative technology (groupware)[19] mediated Virtual Design Studio as a dynamic knowledge building community, educators can engage pedagogical concepts that are driven by constructivist learning strategies, thus ensuring that the interactive process of the continuous optimization of design criteria integral to such a context is informed by the artistic tradition. This approach appears to rely considerably on the integration of a philosophy of objective environmental form with a philosophy of subjective experience, neither of which can meaningfully affect any dimension of the human experience independently of the other.

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