An Experimental Pedagogy of Concept Development in the Introductory Architectural Design Studio

İpek Gürsel Dino

Middle East Technical University, Department of Architecture, Universiteler Mah.,Dumlupinar Bulvari, No:1, 06800, Ankara, TURKEY

Tel: +90 312 2107284

ipekg@metu.edu.tr

ABSTRACT

The introductory architectural design studio has a significant role in design education, as the students are required to synthesize both a physical and conceptual response to various design issues without any prior knowledge or practical experience. We present an experimental educational approach that we developed for and implemented in the introductory architectural design studio, which compromises between direct instruction and self-exploration. In this approach, design learning and concept development are processes of discovery and exploration that result from the dynamic interactions between a *concept schema* that we presented in the studio as a pedagogical scaffold, and the students' internal *cognitive schemas*. We consider students' *schema* development as a complex process of emergence and self-organization, during which new meanings and value systems arise through the acts of deconstructing and reconstructing the *concept schema*. In this paper, we discuss the theoretical foundations, structure and application of this approach and present the student work that support its use in the architectural design studio.

Keywords: architectural education, first year design studio, concept development, schema

1. INTRODUCTION

The design studio plays an important role in the formation of a designer's identity; therefore it is placed at the very core of the architectural design education. The studio is where design knowledge is applied, and design activity regarding the generation and evaluation of design alternatives is learned and practiced(Gross & Do, 1997). The methods of design teaching are rather unique, as the skills, language and approaches in a design problem are taught through experience rather than explanation (Ledewitz, 1985a). The individuality and autonomy of the designers are expected to flourish as they gain experience during their education, and as the "wickedness" of design problems increase by time. The freedom that the designers experience during design is valued, so the heuristics of design is left largely implicit in the studio.

This indirect educational paradigm in the studio typically calls for a certain level of design expertise to be able to cope with the idiosyncrasies and uncertainties of rich design environments. Introductory design courses, however, are haunted by sever a peculiarities. First and foremost, design activity demands challenging transformations in students' cognition and learning. The departure from conventional learning methods of pre-architectural education, in which the acquisition of knowledge precedes its implementation, initially brings about a great degree of confusion for design students. The simultaneous act o flearning *while* designing puts great pressure on the designer especially during creative design with no definitive or objective form of designing (Sachs, 1999). Such implicitness might lead to shallow cognitive conceptions and eventually hinder the construction of a rich language of design early on during design education.

The first year architectural studio education is rooted upon the individual designer and a constructive dialogue between his/her cognitive state and the educational settings. The challenge here is to motivate the novice designer to grow beyond his/her previous experience and to acquire relevant knowledge, skills and theoretical positions. Previous mechanistic approaches to design as information processing or problem-solving, and the two-phase analysis-synthesis model have long failed, giving way to the idea of *design as exploration* based on observation, inquiry and generation. What is needed is an epistemological and methodological shift in design pedagogy that can be based on the theories on complexity, one that moves towards the complexification of the *problem setting* and the complexification of the *design process*(Findeli, 2001).

In this regard, we problematize the introduction of basic architectural concepts in the design studio, the ways in which they can be investigated to raise a critical understanding, and be operationalized during design synthesis. We propose an experimental pedagogy for the introductory architectural design studio that emphasizes concept development. Learning is achieved through the reflective construction of the students' internal *cognitive schemas* while being supported by a *concept schema* that we readily provide as conceptual scaffolding. The *concept schema* functions as an ontological construct that brings conceptual clarity to the central issues in the design studio and their interrelationships: program, structure and context. The students initially need to interpret and appropriate the *concept schema* as a prescriptive tool that guides learning. As the students' familiarity with the concepts increases, they are expected to subjectively transform it towards reconstructing their own *cognitive schemas.* As such, the concept schema is actuatedas a complex system that can self-organize, adapt and evolve towards developing a personal theoretical position.

In this paper, we first introducethe pedagogical foundations of our approach on an interdisciplinary framework that crosses between architecture, education and complexity theory. Then, we present the structure and an experimental implementation of this approach on the first year design studio in the Department of Architecture at Middle East Technical University. Finally, we discuss the potentials of this approach for the beginning design studio, and its limitations for the same level and beyond.

2. THE PEDAGOGICAL FOUNDATIONS OF THE INTRODUCTION TO ARCHITECTURAL DESIGN COURSE

2.1. The Importance of Conceptual Development in Architectural Design

Design artifacts, implicitly or explicitly, all involvesome degree of value judgment regarding their quality. The *design concept* is one of such key indicator, capturing the underlying idea, or the essence, around which the whole design is organized. Good design is characterized by design concepts as "a very few major dominating ideas which structure the scheme and around which other relatively minor considerations are organized" (Lawson, 1994). As a general principle, designers start to construct concepts (or mental representations) of their operational domain on the fly early on during design exploration, and continue to develop them throughout the process. The design artifact and the concept are engaged in a continuous dialogue, such that they inform and form each other: "the concept allows the architect to impose an order on the design while the design enables him to explore and develop the concept" (A. Heylighen, Bouwen, & Neuckermans, 1999).New design concepts are generated as the designer's *cognitive schema* is activated to interpret the design problem. Here, the designer's prior experience provides a means by which to understand the design context.

In the design studio, concept development is crucial because it provides a ground on which the design artifact can be critically evaluated. A concept encompasses a design artifact's coherence and meaning, and is an indicator of the intellectual ability of the designer. The reflection of this view in the design studio entails that a design artifact and the concepts that underlie it form a tightly-coupled system where one generates and enhances the other.

2.2. A Hybrid Pedagogy For The Novice Designer: Between Direct Instruction And Self-Learning

There are various models of learning that suggest divergent approaches to the purpose and process of education. Amongst these, the arguments on instructional guidance in teaching are divided between self-discovery with minimal guidance (i.e. discovery learning, inquiry-based learning, experiential learning, constructivist learning), and direct instruction that provides the students with the concepts and procedures of a domain(Kirschner, Sweller, & Clark, 2006). The former supports that effective learning can be activated as the students construct their own knowledge and value systems through their engagement with authentic problems and individual experience. Specifically in design, it emphasizes learning through individual discovery, thereby liberating the designer from *a priori* constraints and biases. Architectural design studios typically follow this approach, where the student is assigned a design problem on which he/she needs to explore specific ways of synthesis. Here, the autonomy of the designer is paramount, and subjective interpretation and intuition are cherished. The latter, in contrast, advocates a rather objective approach that places emphasis on deductive learning through direct guidance and explicit instruction (Gagné, 1985). Direct instruction has proven to be effective in teaching well-structured basic tasks that have easily-identifiable procedural steps, such as arithmetical calculations or technical reading.

These two approaches have different pedagogical implications for novice designers and their *cognitive schema* development. A *cognitive schema* is a mental framework that represents aspects of the world, with which individuals understand and organize information and make decisions accordingly. When new information is received, it is internalized either by assimilating or accommodating, depending on whether it is already in line with one's existing *cognitive schema* (Piaget, 1952). The distinguishing characteristic of novice designers is their lack of well-developed schemas that they can readily operationalize and integrate new information with. On the contrary, they tend to carry over to the studio their naïve preconceptions attained from previous experiences. As a result, they might fail to recognize the inherent complexity of design problems and eventually fold back to oversimplified strategies, or be misguided by prior misconceptions. This condition leads to a dangerous threat of *ideation without substance*, hampering conceptual development in design *(Newstetter & McCracken, 2001)*.

In the first year design studio, neither self-discovery nor guided instruction design pedagogies alone can fully support design activity. Self-discovery runs the risk of delegating much of the burden of concept development to novice designers. As the cognitive load associated with experiential learning is shown to be too heavyfor novices within complex learning environments (Sweller, 1988), schema acquisition through free exploration may impose too much working memory load on them, and eventually impair learning. On the other hand, direct instruction too fails to successfully address the idiosyncrasies and complexities of design, as well as the diversity of individual design approaches. Direct instruction is a product of rational thinking. Their normative, sterile world view is in contrast with design studios that are characterized by multiple and sometimes contradicting goals, implicit theories and conditions of "inexpressibility, vagueness and ambiguity" (Ledewitz, 1985b).This dichotomy is also clearly evident in Schön's (Schön, 1983)distinction between technical rationality -which suggests that objective and rational knowledge exists independent of the designer-and reflection-in-action, wherein the designer's interaction with the design setting both redefines the design problem and reveals new meanings.

2.3. Our Approach

Under such challenges, we face the question of how studio teaching that can negotiate between self-learning and instruction. We support that a balanced pedagogical approach that introduces the basic concepts of architecture while raising a critical understanding, and operationalizing these during creative design is necessary. We develop and implement an experimental design pedagogy for the introductory architectural design studio by synthesizing the existing theories of learning and complexity. This pedagogical view draws from and compromises between the direct instruction and discovery learning approaches. In this regard, we address the difficulties of novice designers in registering the newly presented knowledge to their *cognitive schemas*. We aim to alleviate this disadvantage by introducing relevant concepts to students through a *concept schema*that we developed. This schema is similar to an ontology that aims to conceptualize a domain by consensus, to be able to raise a common understanding across individuals operating within that domain.

The *concept schema* acts an instructional scaffold that controls and constrains the conceptual domain of the design studio. It structures the design domain on an ontological level, therefore it can be initially misconceived as normative and *top-down*. But at the same time, it does not impose rigid objective facts prescriptively on the students. Instead, it acts as a foundation onto which the students can build their individual experiences and construct new value systems, giving rise to *a posteriori* alternative interpretations. To this end, the schema needs to be first *deconstructed* by the students so to be able to *reconstruct* new value systems and internal *cognitive schemas*. In an active effort to connect the *cognitive schema* with what is learned in the environment, the learner subjectively filters it through his/her mental categories to reorganize and reconceptualize this information. Knowledge constructed in this way may be highly biased, imprecise and even incomplete, as the mind selectively distorts while categorizing information. Such vague conditions are typical characteristics of creative design, wherein a clearer conception of the *concept* doesn't materialize until the end of the design process (Lawson, 1994). Therefore, they are quite acceptable in design, as an objective reflection of reality is neither needed, nor achievable (F. Heylighen, Cilliers, & Gershenson, 2006).

	The concept schema	***Designers' cognitive schemas***
Organizational principle	Top-down	Bottom-up, self-organizing
Purpose	To describe and control	Order emerges from parts; development is autocatalytic
Type of knowledge	A priori	A posteriori
Characteristics	Generic, rigid, static	Subjective, incomplete, transient, emergent, biased
Education approach	Direct instruction	Self-exploration and discovery

In the design studio, the *concept schema* fulfils the potential to motivate and mobilize the operational resources of the designer towards new meanings, conceptualizations and personal value systems. Here, the critical issue is the designer's vigorous involvement in the actuation of the *concept schema* as a *complex system* to create generative conditions for experiential learning. Complex systems are defined by many interconnected parts (or design concepts) and their exchange mechanisms that give rise to emergent form or behavior. They rely on the interaction between components rather than a central control mechanism. During learning, the *cognitive schema* acts as a complex system that binds in representations of new information in relation to the existing mental structures, in the same way that a stimulus to a network spreads activation and triggers the excitement of all associated nodes during information retrieval (Collins & Loftus, 1975).Learning is an emergent outcome of many decentralized and local bodily interactions with the environment. Comprehension occurs not only by a mechanic transfer of information into the memory, but through the integration of what is observed in the environment with what already exists in the memory. The coupling of the environment and the cognitive structures facilitates the adaption of cognition to the idiosyncrasies of the context, acting as a tool for developmental change (L. B. Smith, 2005). The schema as a discrete, decomposable device for knowledge representation(Rumelhart, 1978) can be flexibly adapted and extended to accommodate new knowledge. Here, learning can take place even when learning tasks and goals are not pre-specified, through environmental contingencies creating a context for spontaneous self-exploration of the movement space.

2.4. The Course Structure

The proposed approach is implemented during the Introduction to Architectural Design studio course, which is taught to the first year architecture students of the Department of Architecture at Middle East Technical University. The course is preceded by the ARCH 101 Basic Design course and followed by a body of six architectural design studios. Arch 101 aims at establishing the basic skills of design through the exploration of visual organization, form and space. The students are expected to understand and implement principles of design such as design elements, organization and tectonic articulation while working with logical design steps by means of design rules or procedures. The definition of voids by design elements, which will lay the foundation of the design of architectural spaces in the following design studios, is prioritized. The design studios that succeed ARCH102 deal with various methods and principles of solving architectural problems. The students are expected to carry out design projects with increased scale and complexity of program, structural systems and contextual issues. The problems are strongly rooted in the realities of practical design settings and problems, where novel conceptual and technical approaches are expected.

Bridging between two sides, ARCH102 holds a significant role in the design curriculum in the way it reconciles the divide between abstract design principles that are divorced from socio-cultural origins on one side, and contextual architectural problems on the other. The course's aim is to introduce the students to the practice and theories of spatial design, and set up a terminology of the fundamental conditions of architecture that are operationalized through design practice. The students are expected to investigate and explore architectural notions and physical elements that define architectural space, and acquire the necessary knowledge, attitudes and skills to design small scale architectural environments. We initiate learning with a *concept schema* as described above, which is presented to the students implicitly and gradually by means of a series of design exercises that build upon each other. The *schema* is structured in two orthogonal axes, **conceptual** and **developmental**. The conceptual axis can be considered as a structured subset-or a microworld- of the design domain, where we define the studio's intellectual foundations and establish the design vocabulary: architectural program, tectonics and context.

Program

Architectural program is the key to a meaningful design that satisfies the design requirements. We support that architectural spaces cannot be activated through a program but through the notions of the experiencing body, movement and events (Tschumi, 1994). Therefore in the studio, we highlight the close association between program and events, such that program is predicated upon events, both unscripted and scripted, that occur in space.

Tectonics

The physical elements and systems that materialize a design are an issue of technical knowledge, as well as an architectural one towards the making and sensing of spaces. A critical consideration of the issues of structure, construction, materials and their designerly use in architecture is necessary. We aim to raise an empirical inquiry on the interrelations between tectonics, architectural form and space.

Context

Architecture is about responding to the existing conditions, or the context, as much as designating new conditions to emerge through design. Context characterizes a site by means of the material (form) and immaterial (narrative) in multiple layers, including the sociocultural, economic, political and morphological. These layers act at a much larger scale than the intervention itself, and require a rich theoretical understanding to operationalize during design. We aim to avoid the confrontation of novice designers with such advanced issues of context at this early phase of design education. Therefore, it is only the most basic layer, the physical landscape, which we are after as the fundamental component of context.

The developmental axis defines the order with which the concepts in the schema are to be introduced to the students. Here, the study of each concept is decomposed into three sub-phases, resulting in a hierarchically organized solution space. A sub-phase is a design exercise that facilitates exploration (the understanding of concepts) or synthesis (the act of designing).

During **concept exploration,** the students take the first steps in understanding the relevant concept in the schema. Such an understanding materializes itself in the explicit demonstration of the basic principles that underlie the conception and generation of the subject matter. We use abstract diagrams as representative tools to conceptualize information and form theories about the nature of ideas, objects, processes, etc. Diagrams can unravel possible relations of matter and information.

Therefore, they are valuable instruments in achieving visibility of complex and dynamic systems, anticipating new organizations and relationships (Allen, 2009).

During **realization,** the students start designing architectural interventions on the given concepts. The critical point in this phase is the simplification of the design problem by suppressing the issues that are too advanced for novices. The students afraid from the unnecessarily complex conceptual layers to reduce their cognitive load. This is also consistent with the idea of instructional scaffolding, where the temporary support tools that help the learners in their *zone of proximal development* construct their knowledge are only gradually removed by time (Vygotsky, 1980).

During **appropriation,** the students are faced with the whole complexity of a small scale architectural design problem in the form of a design project that brings together all the schema concepts that have been separately explored. The students are expected to consider many design issues at once, and find ways to integrate and negotiate various interrelated concepts. The ways in which the conceptual layers of a design problem interrelate, coexist and co-evolve is to be experienced in this phase.

Semester content

In the ARCH101 studio, the human body and different forms of embodiment play a key role as conceptual generators in the production and consumption of space and architecture. What is sought after is not the idea of abody that is reduced to the classical ideals of proportion or anthropometrics, or one that represents or attributes meaning. Rather, we are interested in the conception of a body that has the potential to propose multi-layered architectural narratives based on performativity and practice. The body and architecture are not dissociated or discrete objects; the autocatalytic material flow between them has the potential to codify the knowledge of architecture (C. L. Smith & Ballantyne, 2010). The emphasis on the human body calls into question the everyday practices that "shape the conduct of human beings towards others and themselves in particular sites … concerned with the performative presentations, showings and manifestations of everyday life" (Thrift, 2008). As such, new ways to explore the interrelationships between the material world of the body-as-subject and the phenomenological world of the body-as-subject can be opened, based on the idea of the human body and its movement as the generator of events in space (Tschumi, 1994).
The dynamic body and human activities can give rise to the formulation of an architectural program. In the studio, we focus on Parkour, an extreme sport developed from military obstacle course training. Parkour involves fluid human movement between two points, while exploiting the encountered physical objects and barriers not as

obstacles but opportunities for movement. It offers alternative ways of interacting with the physical world and the urban environments. It is also a spatial activity, due to the experiential and cognitive processes they involve regarding urban reinterpretation. We placed the idea of the dynamic body in the center of the *concept schema* (Figure 1). We engage the students with a number of design exercises that explore key architectural concepts (program, tectonics and context) by means of the human body. In this manner, the human body acts not only as a metaphor but also a analytical tool that establishes a degree of familiarity on these concepts, supporting the process of learning and internalization following a connectivist approach. The exercises build upon each other and eventually culminate in the design of an architectural environment that can facilitate Parkour.

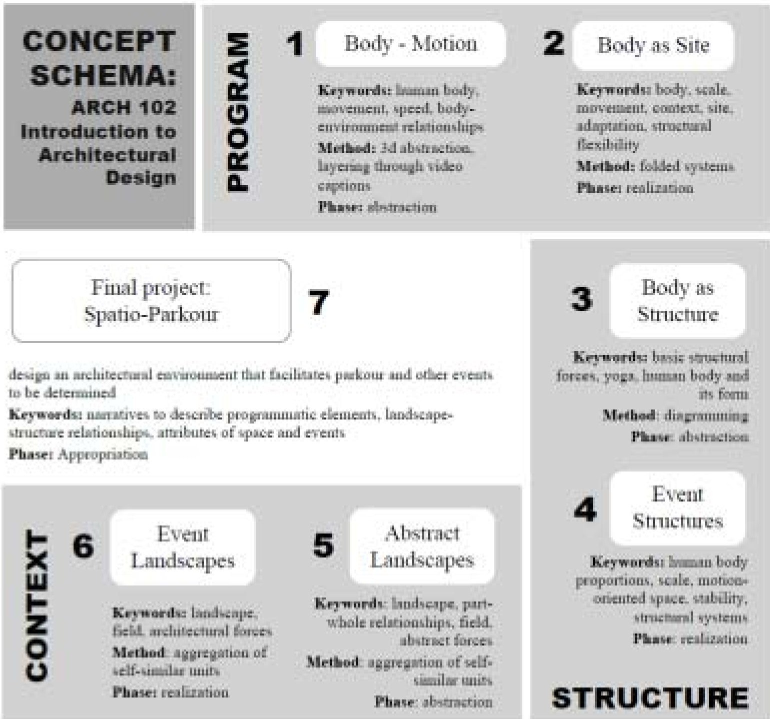


Figure 1. The concept schema

PROGRAM

1. Concept exploration: Body – Motion diagramming (2 weeks)

In this exercise, the students were expected analyze concepts of movement, time and the interactions between the human body and the physical environment. Starting with any video clip that captures a parkour move, the students printed several snapshots on transparent acetate paper and placed them in layers on a board. Following, they used these layers as a basis on which an abstract representation of the parkour movement is constructed using materials such as wooden sticks, metal wire, balsa wood, cardboard,

string etc. The use of different materials and constructive techniques expressed the parts of the physical environment that the parkour movement interacts with. See Figure 2.
Keywords: human body, movement, parkour

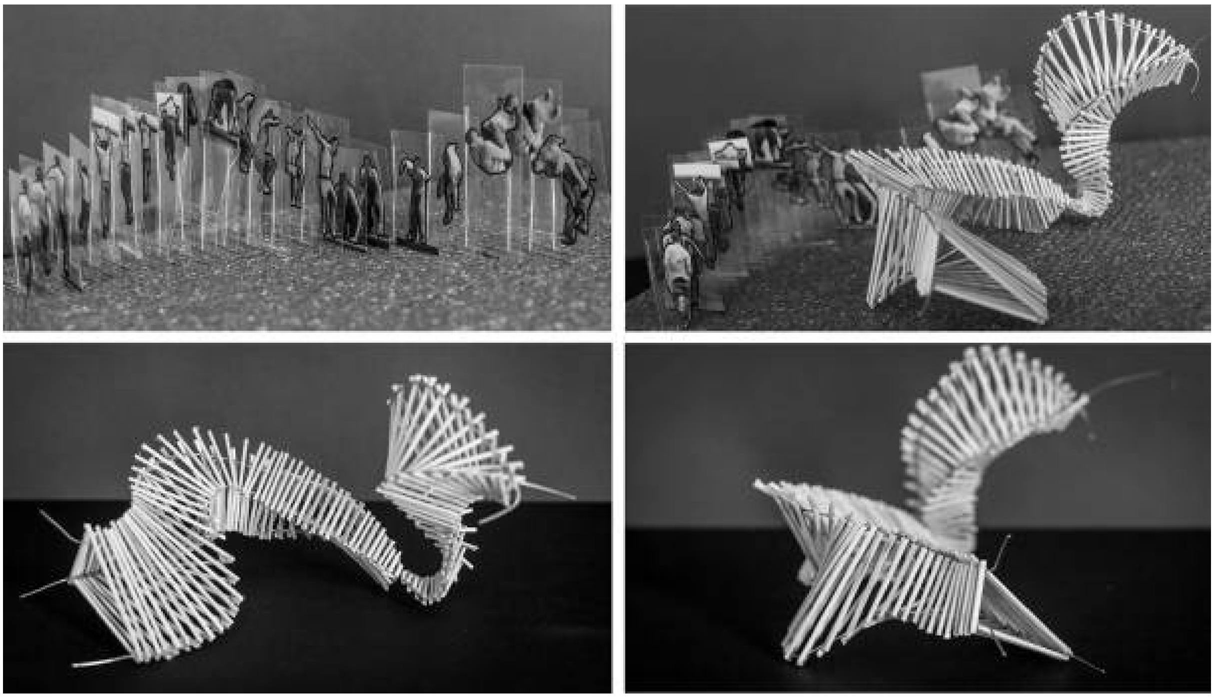


Figure 2. Student work, Body – Motion diagramming (student-name). The design is constructed within a framework that both defines and constrains the body movement. The density of the balsa sticks are varied to materialize the "intensities" of the movement such as speed, orientation, physical effort.

2. Realization: Body as site (1 week)

This exercise dealt with the dynamic body as an alternative site for design. The students first focused on a specific part of their bodies and its movements. Then, they designed a system that forms a physical relation with that body part by (partially) covering and adapting itself to its movements. As such, the human body acted as the landscape on which an intervention was to be proposed. The system was to be composed of folded elements, and needed to adjust itself to the body's movements by exploiting the flexibility of folded systems. See Figure 3.

Keywords: body, scale, movement, context, site, adaptation

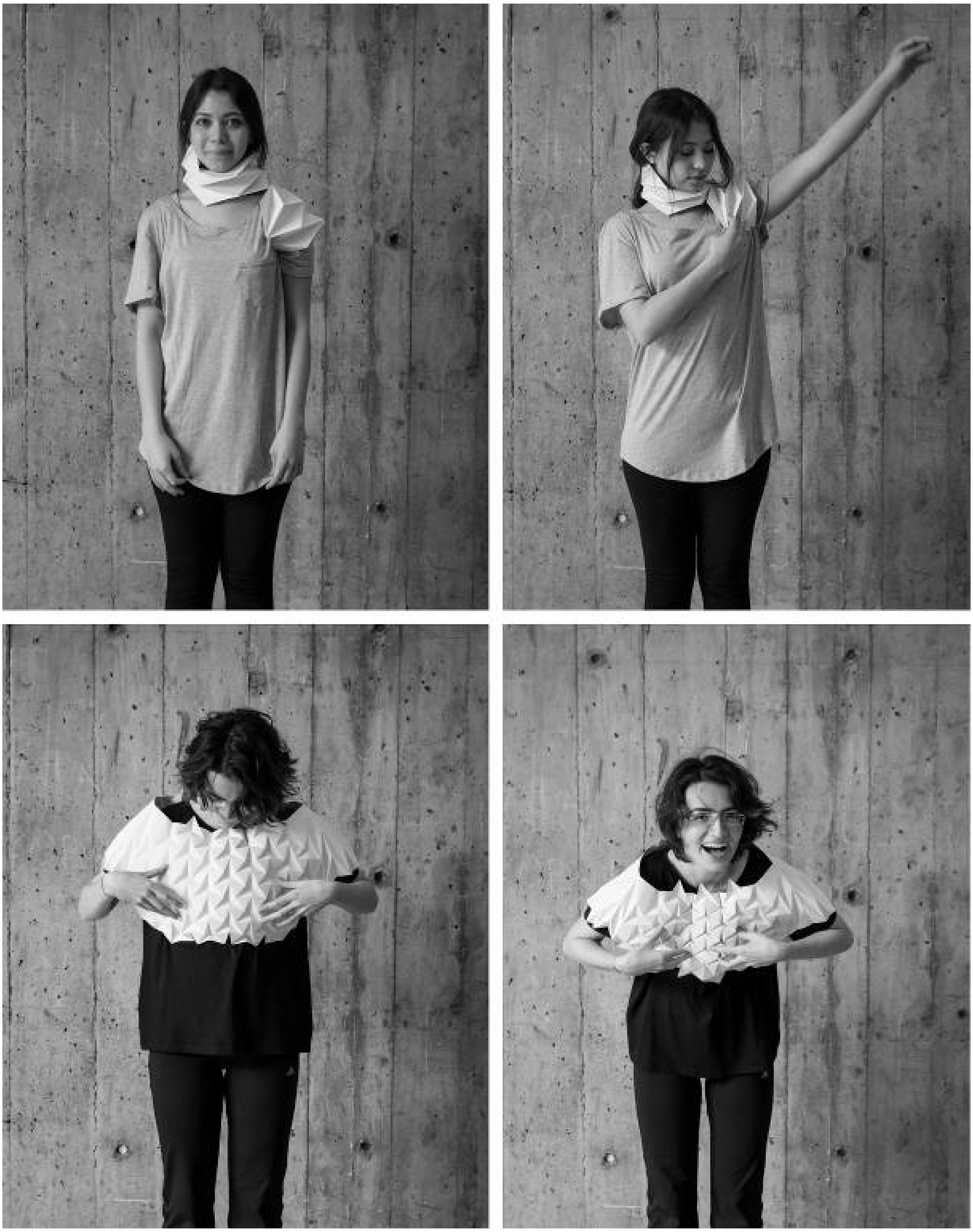


Figure 3. Student work, Body as Landscape (student-name). By applying a texture, the paper assumes the behavior of shell structures enabling complex double-curved surfaces, similar to those of the human body.

STRUCTURE

3. Concept exploration: Body as Structure (1/2 week)

The human body, like all structures, has physical forces acting upon it: The muscles and bones allow us to stand, move and maintain a balanced position by adapting itself to external conditions and forces. In this exercise, the human body as a familiar context was taken as a model through which structural concepts can be understood.The students were asked to select a yoga pose and analyze the body’s reaction to the forces for maintaining its stability. Then, by identifying the different types of structural forces that act in different ways on the body, they were asked to represent these forces diagrammatically.

Keywords: basic structural forces, yoga, human body and its form

4. Realization: Event Structures (3 weeks)

This exercise involved the design of a tectonic structure that can facilitate and organize various parkour movements. The students were to select at least three parkour movements, and design a structure in which these movements can take place. We aimed to challenge the conventional notions of landscape – structure relationships, and seek for new potentials for previously unexplored structural morphologies. Therefore, we required that the structure transfers its loads to a vertical surface, thereby detaching itself from a horizontal ground and the conventionalities of the top-bottom duality. As such, the complexities regarding the relationship between structure and landscape are delayed until the final exercise. See Figure 4.

Keywords: Human body proportions, scale, motion-oriented space, stability, structural systems

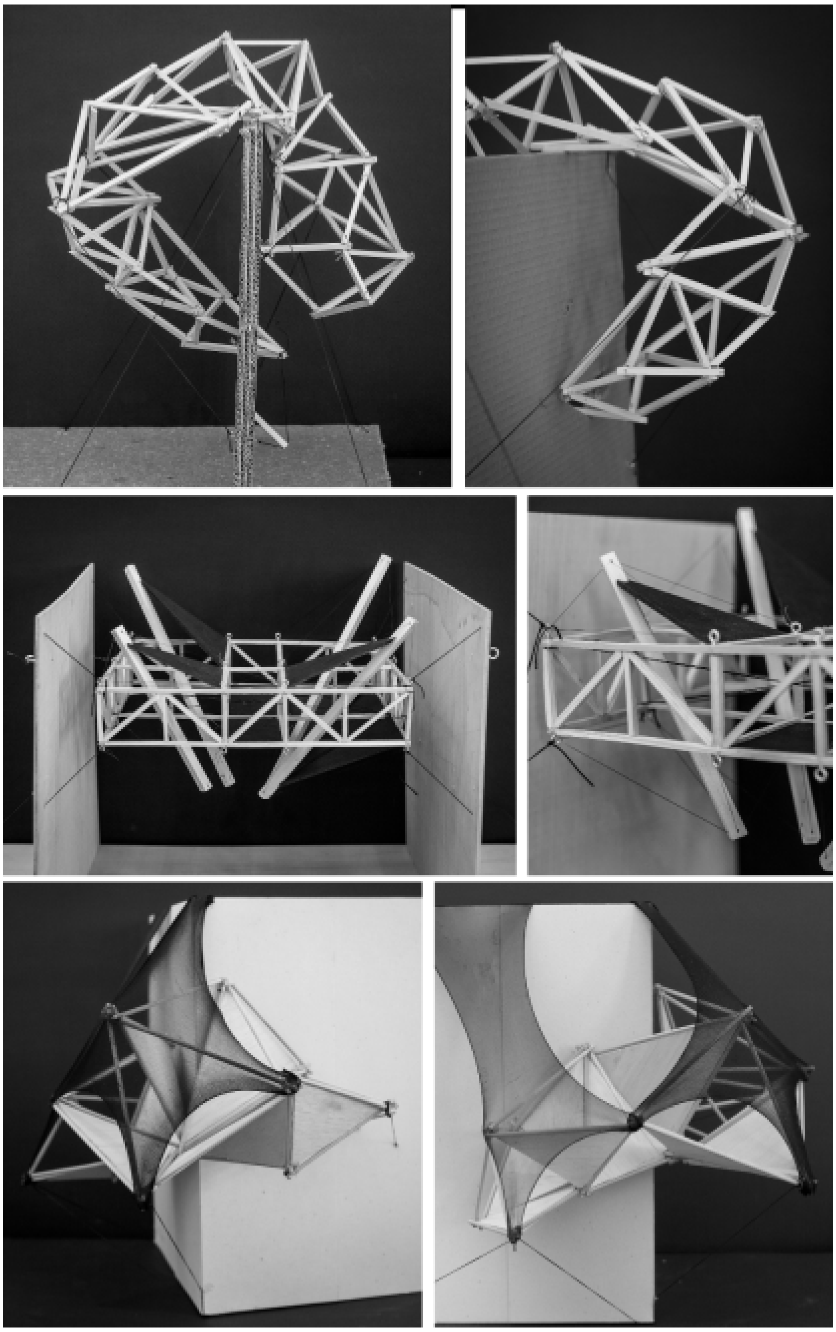


Figure 4. Student work, Event Structures

(top): An alternative relationship between the structure and the vertical landscape is proposed where the landscape not as a continuous and intact entity but one that is embraced and invaded by the structure itself.

(middle): A 3D truss system is designed that suggests a hierarchy of linear and planar structural elements that can also facilitate bodily activities.

(bottom): A hybrid structure that combines tensile elements and a rigid frame that provides different surfaces facilitating different parkour movements such as sliding, climbing, bouncing.

CONTEXT

In this exercise, we are motivated by the notion of landscape as an ever-changing material system of interactions and interventions that facilitate occupation(Corner, 1999).The students were expected to design abstract landscapes by operationalizing the concepts of *field* and *aggregation*. A field condition is "any formal or spatial matrix capable of unifying diverse elements while respecting the identity of each" (Allen, 1996). A field can give rise to whole form by organizing the aggregation of interrelated parts. Fields are characterized by part-to-whole relationships, differentiation, multiplicity, as well as non-hierarchical organizational principles. The resulting landscape is not merely representational but also structural, in thatit has to operate as a system with all its components to maintain stability and rigidity. As such, students' prior experiences on structures need to be reoperationalized in the making of the landscape. This exercise was carried out in two phases.

5. Concept exploration: Abstract Landscapes (1 week)

Natural geological formations and the procedures of their formation (the kinds of physical and material forces acting on the matter, and the ways in which matter was reorganized as a result) were to be analyzed. These procedures were to be used in the design of an abstract landscape.

6. Realization: Event landscapes (1 week)

In the second phase, the above-explored procedures were to be adapted for the design of an event-driven landscape to be shaped by a spatial agenda. In this step, parkour acted as the abstract force behind the formation of this landscape by informing and guiding the interrelationships between units in time and space. As such, the causal relationship between a landscape and events could reveal itself. See Figure 5.

Keywords: landscape, aggregation, self-organization, part-whole relationships

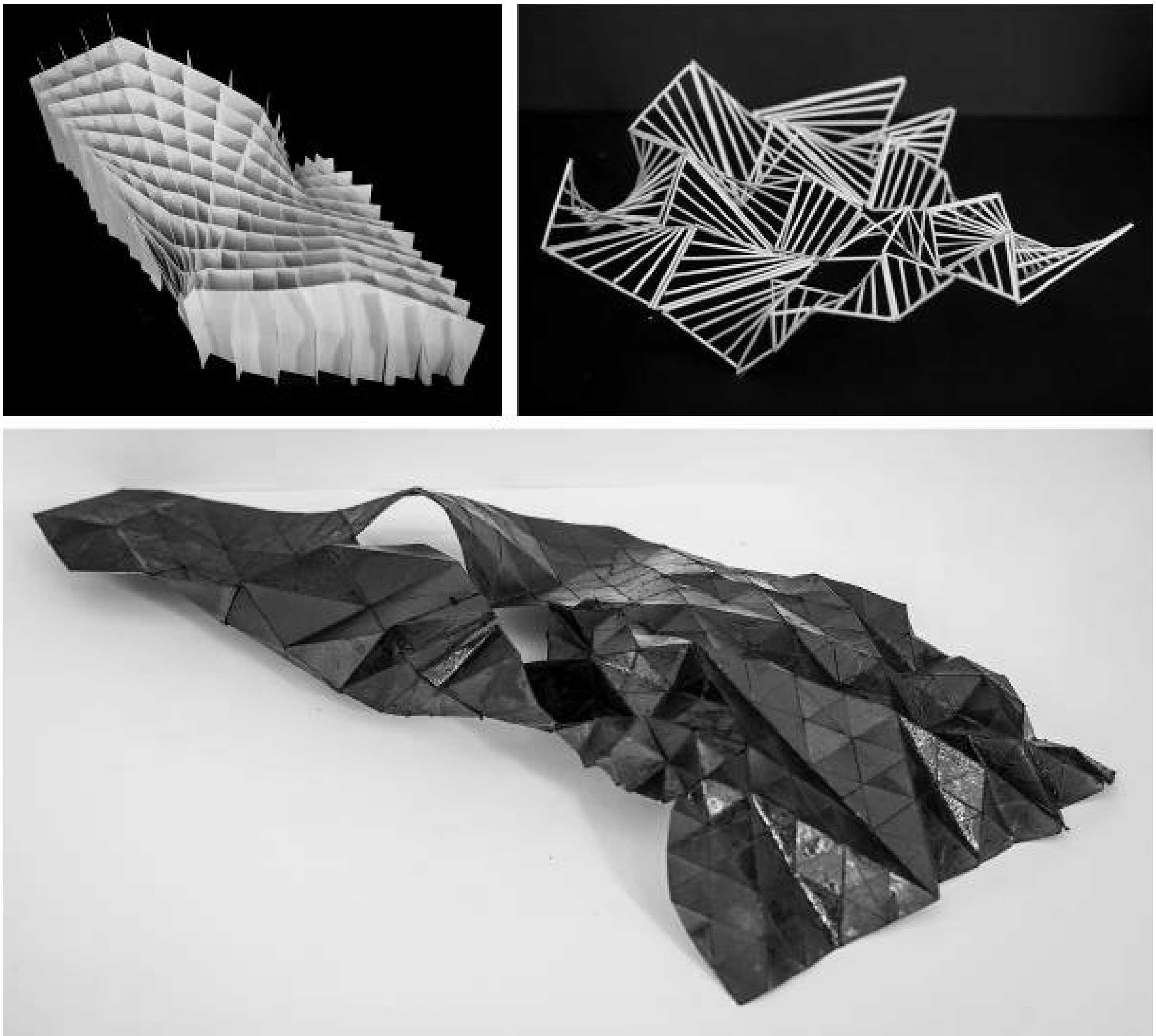


Figure 5. Student work, Event landscapes.

(top-left): A free-form surface is created using a waffle structure with the interlocking of curved profiles.

(top-right): A number of hyperbolic paraboloid surfaces are aggregated that can either form a seamless event-surface, or create gaps that intentionally interrupt and redirect the body movement.

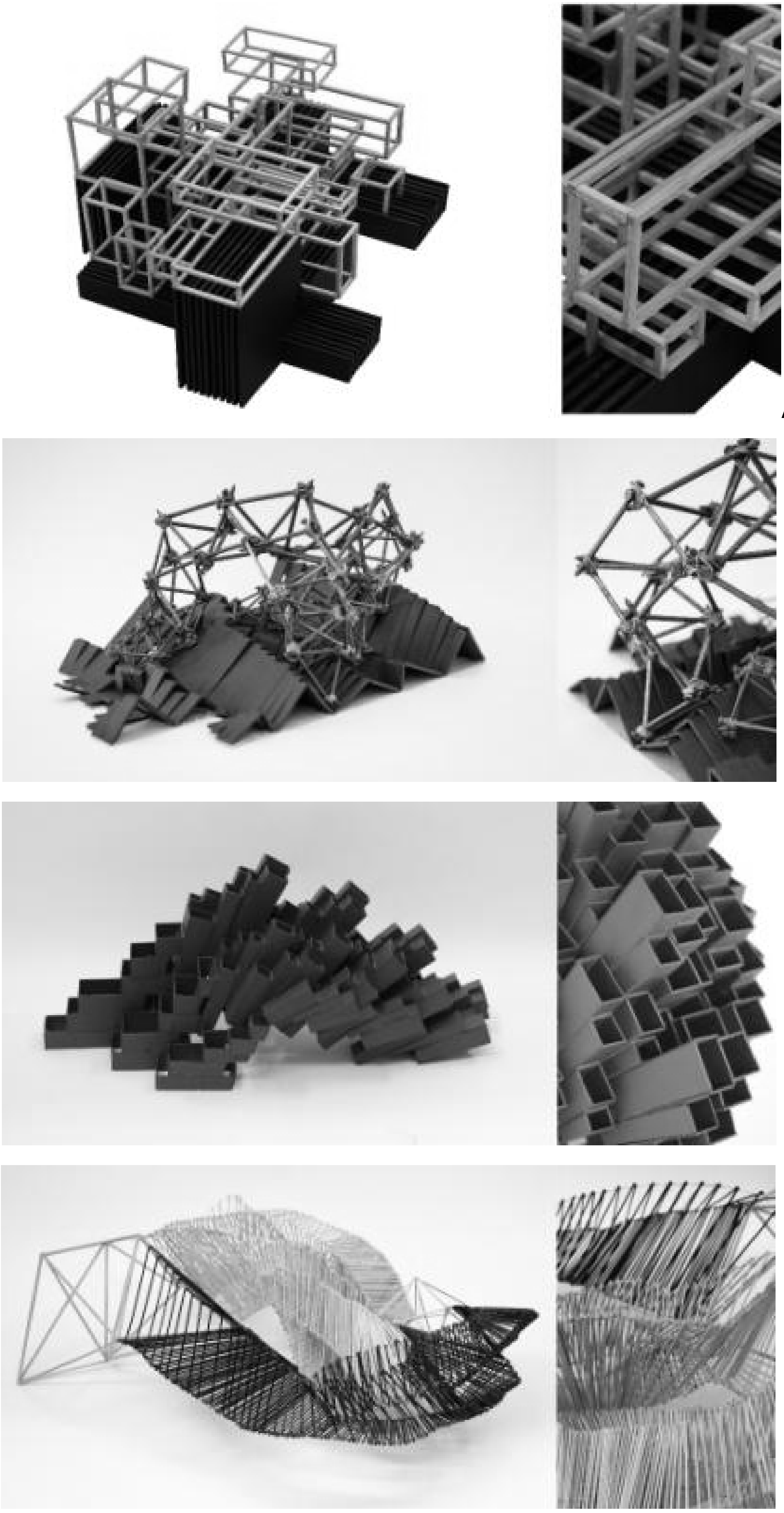
(bottom): The principles of folded plate structures are used towards the definition of a flexible and free-form surface that can accommodate diverse bodily activities.

7. Appropriation: Spatio-Parkour (5 weeks)

The three previously explored issues are intrinsically inseparable during the design of an architectural intervention, generating multiple or simultaneous levels of meaning and resulting in overlapping paradigms. In the final project, we aim to erase the conceptual boundaries that the *concept schema* inherits, and facilitate the synthesis of the students' own *cognitive schemas*, leading to new readings towards intervention, context and landscape.

In Spatio-Parkour, the students are expected to design an architectural environment that has the potential to facilitate parkour and other related events that are to be proposed by the students. First, the students are required to designate the programmatic elements that are related to parkour in the form of a fictional narrative, or a scenario. The scenario here acts as a device that reveals the events leading to the organization of architectural spaces. It coordinates the design of the architectural environment, including the landscape and the tectonic structure. Regarding the former, we support that landscape is not a static condition; instead it is to be built through a constructive procedure, while negotiating the constraints of the program and the tectonic structure. The tectonic structure, together with the landscape, should facilitate the events proposed in the scenario and produce the required spaces. The architectural environment is expected to involve all attributes of space (including enclosure - openness, ascend - descend, opaque - transparent, penetrable - impenetrable etc.), and attributes of events (including temporary - permanent, planned - spontaneous, mobile - stationary, public - individual, singular - multiple/juxtaposed etc.).

The student projects showed much conceptual and formal variation due to the open-ended design brief. Most of the projects were motivated by the potentialities of the interrelations between the landscape and tectonics, and sought to find a common formal and procedural language between these two, while valuing and exploiting their differentiation through materials, surface qualities, solid-void relationships and construction techniques (Figure6). Alternative interpretations that challenged the conventional top/bottom relationship between stereotomics (the solid ground) and tectonics (the lightweight structure) were proposed. Such approaches blurred the distinctions between these two, as they intertwine into one hybrid entity that performs both as the ground and the superstructure. These readings questioned the nature of landscape, where it is no longer a solid continuum that underlies the tectonic structure, but a part of an integrated system that is synchronously mobilized through parametric relationships. The role of the narrative also played a central role in the conception of design, which was materialized through the formal tension and material expression of the tectonic structure. The generative morphology of the landscape was articulated as a permeable boundary that offers alternative modes of inhabitation, and questioned the notions of inside and outside.



A

B

C

D

Figure 6. Student work, Spatio-Parkour

(A): The nested planar elements constitute the prismatic components of the landscape aggregation. The structure speaks the same visual language with the landscape, giving way to planned and unplanned spatial qualities.

(B): The main design concept is the interpretation of parkour activity is as a cyclic movement between multiple nodes. Alternative paths interweave and give way to accidental encounters, wherein material and spatial differentiation is invoked.
(C): The landscape and the structure grow together in a process of organized randomness. The interplay between the morphology of the solid landscape and the lightweight structure is the main visual concept.
(D): The aggregation of rectangular prisms as the unit of landscape aggregation provided a permeable boundary that has the capacity to provide inhabitation in different directions and capacities.

The exemplary student works demonstrate the different ways in which the *concept schema* was subjectively internalized and creatively operationalized in design. Moreover, a concept is neither a static, nor an isolated construct; it is an active component of the intellectual processes that facilitate communication, understanding and problem-solving in design education (Delage & Marda, 1994). Design learning involves the *deconstruction* of the concept schema and the consecutive *reconstruction* of the student's internal cognitive schema. It is evident in the student work that the role of parkour as a concept generator eventually gave way to alternative readings that helped new design scenarios emerge. Here, there is nothing provably right or wrong in the concept per se; it attains meaning and value only in relation to the design artifact that it brought about. This process of schema construction, we observe, demonstrates several properties of complex systems that we discussed in the previous section. Emergence, the idea that novel global patterns arise from the component level, prioritizes the interrelationships between components and their exchange of information. As the students learn, it is largely the conceptual associations between the schema components (i.e. between landscape and intervention) that motivate and nurture design conception, rather than the components alone. Each student brings in his/her own intellectual heritage to the studio, with which notions are subjectively processed and interrelated. Moreover, new knowledge does not linearly accumulate in the order in which it was presented in the *concept schema*; it self-organizes throughout the semester through cyclic processes that involve repetition, recursion, as well as positive and negative feedback. Throughout the studio, design artifacts and the students' cognitive schemas build up and evolve together. However, we consider such acts of cognitive schema construction at the first year studio only the beginning of a designer's intellectual development; the following design studios are expected to continuously and actively consolidate new design knowledge and various activities of designing.

3. DISCUSSION

The beginning of architectural education plays a crucial role in acquiring a body of knowledge, a theoretical position and the skills of creative and technical design. The design studio, which is placed at the core of the curriculum, entails a great deal of confusion for the students as there is no readily usable methodology of design. Therefore, the pedagogy of the first year design studio needs to be carefully conceived so to create an environment of reflective critical thinking and stimulate processes informed by a strong conceptual foundation.

In our work, we problematize *cognitive schema* construction during studio learning. During this process, knowledge does not aggregate linearly; new concepts, meanings and personal value systems emerge from the cyclic process of conceptualizing and designing. Here, the *cognitive schema* acts as an *open system*, interacting with its environment by exchanging insight and information. As such, it adapts itself towards reaching new cognitive states. In the studio, many students departed away from parkour towards new scenarios and alternative programs. The ongoing dialectic between the internal and external schemas results in a tension between the actions of experimentation and learning, and the possibilities that action retrieves from the learning environment (van Geert, 1998). During this process, what is perceived in the environment is either assimilated by incorporating it into the existing cognitive schema, or the schema accommodates itself by adapting itself to the newly acquired evidence. In its extremes, external stimuli can have a ripple effect on the *cognitive schema*, triggering a process of drastic readjustment throughout the whole system. Pre-established value systems can be challenged to the extent that the whole schema needs to be restructured. Feedback loops, or reflection-on-action, can act as self-reinforcing or self-correcting mechanisms that can amplify this effect. The cognitive schema as a complex system oscillates between order and disorder, continuously adapting itself to different value systems that it is exposed to. Therefore, internal schemas can be said to be *far from equilibrium*.

In this paper, we presented an experimental design pedagogy that we developed and implemented in a first year design studio, in which we borrowed from teaching approaches of direct instruction and self-exploration. We used a *concept schema* as a pedagogical scaffold that forms the basis of the studio exercises. The traditional means of studio scaffolding are individual instruction and progress reviews through critiques and juries. We regard that these methods fall short of supporting students in concept development, as they merely provide post-design feedback based on what is already explored and considered, but not what lies beyond. In contrast, the *concept schema* we developed encodes and constrains the studio’s intellectual content. We control this content not only through what is contains, but also by the too-advanced concepts that it suppresses, such as socio-cultural contextual layers. Such acts of simplification are necessary to educate novice designers, who do not possess sophisticated cognitive schemas that equip them with tools to perceive complex and meaningful patterns. With the help of the concept schema, the cognitive load and the complexity of problem space can be reduced.

The proposed approach only explains the acquisition and role of declarative knowledge in the design studio. However, the ways in which it can be mobilized during design activity and be transferred into procedural knowledge is to be investigated per context by the studio instructors. During this process, there is the threat of rote learning if the schema is internalized not by argument, experience and reason, but by subjection and convention. Creative design, to a large extent, is a process of unrestricted experimentation that challenges the established order and architectural conventions. Therefore, it is the instructor’s responsibility to point out that there cannot be a one-to-one correspondence between the external and internal schemas; schema construction is always emergent and autocatalytic.

REFERENCES

Allen, S. (1996). Field Conditions. *Architectural Design, 66*, 21-21.

Allen, S. (2009). *Practice: Architecture, Technique+ Representation*: Routledge.

Collins, A. M., & Loftus, E. F. (1975). A spreading-activation theory of semantic processing. *Psychological review, 82*(6), 407.

Corner, J. (1999). Eidetic operations and new landscapes. In J. Corner (Ed.), *Recovering landscape: essays in contemporary landscape architecture*. New York, NY: Princeton Architectural Press.

Delage, C., & Marda, N. (1994). Trans-Formations: The Very First Steps Towards Architectural Concepts Formation. In K. L. Eldridge (Ed.), *Beginnings in architectural education: proceedings of the ACSA/EAAE Conference, Prague, 1993*. Washington DC: Association of Collegiate Schools of Architecture.

Findeli, A. (2001). Rethinking design education for the 21st century: Theoretical, methodological, and ethical discussion. *Design issues, 17*(1), 5-17.

Gagné, R. M. (1985). *The conditions of learning and theory of instruction*: Holt, Rinehart and Winston New York.

Gross, M. D., & Do, E. Y.-L. (1997). *The design studio approach: Learning design in architecture education.* Paper presented at the Atlanta: Paper presented at the Design Education Workshop, EduTech/NSF, College of Computing, Georgia Institute of Technology.

Heylighen, A., Bouwen, J. E., & Neuckermans, H. (1999). Walking on a thin line—Between passive knowledge and active knowing of components and concepts in architectural design: Between passive knowledge and active knowing of components and concepts in architectural design. *Design Studies*, *20*(2), 211-235.

Heylighen, F., Cilliers, P., & Gershenson, C. (2006). Complexity and philosophy. In J. Bogg & R. Geyer (Eds.), *Complexity, science and society*. London: Radcliffe Publishing.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational psychologist*, *41*(2), 75-86.

Lawson, B. (1994). *Design in mind*. Oxford, UK Butterworth-Heinemann.

Ledewitz, S. (1985a). Models of design in studio teaching. *Journal of Architectural Education*, *38*(2), 2-8.

Ledewitz, S. (1985b). Models of Design in Studio Teaching. *Journal of Architectural Education (1984-)*, *38*(2), 2-8. doi: 10.2307/1424811

Newstetter, W. C., & McCracken, W. M. (2001). Novice conceptions of design: Implications for the design of learning environments. *Design knowing and learning: Cognition in design education*, 63-78.

Piaget, J. (1952). *The origins of intelligence in children*. New York: Basic Books.

Rumelhart, D. E. (1978). *Schemata: The building blocks of cognition*: Center for Human Information Processing, University of California, San Diego.

Sachs, A. (1999). Stuckness' in the design studio. *Design studies*, *20*(2), 195-209.

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action* (Vol. 5126): Basic books.

Smith, C. L., & Ballantyne, A. (2010). Flow: architecture, object and relation. *Architectural Research Quarterly*, *14*(01), 21-27.

Smith, L. B. (2005). Cognition as a dynamic system: Principles from embodiment. *Developmental Review*, *25*(3), 278-298.

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive science*, *12*(2), 257-285.

Thrift, N. (2008). *Non-representational theory: Space, politics, affect*. London and New York: Routledge.

Tschumi, B. (1994). *Architecture and disjunction*. Cambridge, Mass.: MIT press.

van Geert, P. (1998). A dynamic systems model of basic developmental mechanisms: Piaget, Vygotsky, and beyond. *Psychological review*, *105*(4), 634.

Vygotsky, L. S. (1980). *Mind in society: The development of higher psychological processes*: Harvard University Press.

Acknowledgements

The author would like to express her sincere gratitude to the other course instructors Prof. Güven Arif Sargin, Türel Saranli, Şenol Yagiz, Fatih C. Öz, Dr. Berrin Çakmakli, Yigit Acar, Aslihan Günhan and Hayri Dörtdivanlıoğlu, and to the students for their creative contributions. The photographs of the student work were taken by Aslihan Günhan and Duygu Tüntaş.