Precedent-Based Learning: An Approach for Studio Pedagogy in the Early Years

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PREFACE

Precedent-Based learning is related to a very old method of teaching, particularly in the studio setting. Usually it takes the form of precedent analysis. An empirical study was conducted in order to better understand how experienced designers use precedents in the course of a brief design session.

Normative theories of learning suggest that success is most likely to be achieved when students learn (1) the principles governing events or phenomenon in a discipline, and (2) ways of applying these principles to specific situations to solve problems of various kinds. We call this the didactic method. In the didactic approach there is a systematic representation of the fundamental principles of knowledge that identify a specific domain upon which a corpus of applications or problem solving skills can be constructed.

In fields that deal with professional practice, for example design, instruction appears to deviate from this pattern in significant ways. Students are rarely given robust principles (ones that hold in different contexts), let alone immutable ones, upon which they can construct designs that can be judged unequivocally or without error. Instead they are given plenty of precedents from which to learn a variety of heuristics. This type of knowledge is fundamentally tacit, situated in a context of extra-domain information, and involving pedagogy that is principally experiential.

In architectural curricula, the experiential approach to learning is omnipresent. Descriptions of design instruction, or for that matter, architectural curricula within which such instruction is found, are invariably of an indirect kind. They describe the stylistic or formal attributes of the architecture that is promoted by the particular pedagogy in order to explain its characteristics, principles and techniques[5,7,8,11,19].

ARCHITECTURAL PEDAGOGY

In one of the most frequently cited schools of education, namely the École des Beaux Arts, the style of acceptable designs, is based on known and carefully documented examples of early Greek and Roman Architecture. Its pedagogic program is described, often, as a function of principles of design derived from these examples. [7] In order to facilitate the production of designs of a similar kind or style, specific principles of composition, media of representation, accompanied with “pattern books” of designs are provided for both instructors and students.

Strictly enforced procedures of design are used to supplement the learning experience of students during the course of their formal training. The pedagogic model is a function of the corpus of designs that the educational system promotes. This connection appears to be inescapable even for other schools of educational thought -- i.e., Renaissance, Bauhaus, Post-Modernism [7] -- or in the case of similar historical accounts by other authors. [17]

The normative model of learning by explicit principles applied to carefully selected instances does not work so well in the context of architectural design instruction. In the case of the École des Beaux-Arts, students apprentice under faculty and upperclassmen following closely the examples set by them and the pattern books. The

principles of composition that they have been instructed to use are not more immutable than the antique styles from which they have been derived. Their dispensability has surely been demonstrated during the International Style a movement, which simply mustered up the resolve to reject patterns of the past and replace them with brand new ones. Thus the students of the Modernists were placed in a mode of inventive rather than imitative design. They relied on none of the historical precedents of the École, regardless of the type of problem that they tackled or the client with whom they worked.

When the International Style gave rise to Post- Modernism there was a return to the incorporation of historical patterns into architectural styles and then into pedagogy. Subsequently during Deconstructivism, instruction of the students changed once again. This time students were encouraged to work from analytical abstractions of form and composition in violation of both the classicist and modernist principles; demonstrating once again that the principles of design are at best volatile.

It is evident then that design instruction represents patterns of learning and teaching that are different from other forms of instruction. Let us now consider some of these differences more specifically.

LEARNING THROUGH PRECEDENTS

Knowledge disseminated in the design studio is often packaged in the form of precedents or generalizations drawn from, at best; a limited number of instances -- rather than from first principles. This is evident in virtually all texts, theses, treatises and papers on architectural education, a fair number of which have been sampled here [6,7,8,9,11,18,19,20].

Precedents in this sense are specific designs or buildings, which are exemplary in some sense so that what architects and students glean from these examples, can support their own designs. These precedents are very often past solutions to specific design problems. Normally, they are used to highlight a handful of design issues: such as, elevation design, systems integration ideas, structural concepts, plan circulation diagrams, section-volume concepts, and so on. In some instances precedents are negative ones, illustrating some sort of a failure and instructing students on what not to do [2].

Learning, in these instances, takes place through examination, analysis and abstraction of the information contained in the Precedent representation by the students, occasionally with the help of the instructor. The format of this analysis is generally well defined at the onset. Students are asked to research a building, collect relevant information, usually along some specific dimensions (like the ones cited above) and present it formally to peers in the studio or the office. In subsequent phases, the role of the Precedent in generating designs is rather irregular. Dictated by circumstances of board-crits or other reviews of the work, which is referred to as a "situational" mode by others,[6] some design rules are abstracted from the Precedents. These are extremely useful in evaluating design ideas or generating new ones. Yet the fact remains that the most productive use of Precedent analysis in design is conducted in an informal and ad hoc fashion.

CONCEPTUAL VERSUS PHYSICAL KNOWLEDGE

Nevertheless the abstractions derived from the Precedents are invaluable in bridging between the "conceptual" and the "physical" variables that are the basis of spatial design.[9] Conceptual variables are the schemata that provide the underlying order and structure for an aspect of design. To provide the various functional and aesthetic values which are the hallmarks of all "good" designs, the physical elements of the building design must be integrated with one another based on globally constraining variables (loosely called "concepts" or "design concepts"), dealing broadly with such criteria as structural integrity, clarity of circulation, appropriateness of proportions, and so on. Most successful designs at least ones that are recognized in the field as notable have explicable ideas underlying these dimensions: for instance, the core and open plan layout of the Farnsworth house by Mies van der Rohe, the served and servant spaces of the Salk Institute by Louis Kahn, the exploded box of Fallingwater by Frank Lloyd Wright. How these abstract concepts in fact give rise to and later are used to justify and explain explicit physical descriptions of designs is a particular skill that the architectural student must learn in school.

This requires that the knowledge of physical elements as well as that of conceptual constructs is readily available to the student. The student must be skilled at using these as the foundation of the design ideas generated and ultimately the drawings that are produced. At Fallingwater, the location of the windows at the corners and the horizontal banding of the elevations by means of inverted beams of the structural system, for example illustrate how the physical elements reinforce the architectural concept and vice versa.

A HANDS ON LEARNING EXPERIENCE

A significant feature of the mechanics of instruction in the design studio is the constant interplay of skill and knowledge or theory and practice. While there may be little in the way of first principles of design, there is a great deal in the way of discovering how principles affect the solution to a specific problem and how specific solutions may illustrate larger principles. Furthermore, this is done in a generate-and-test mode. Students learn by applying principles to designs and inferring principles from designs. Faculty play the role of coach or critic in the course of this. Cognitive skills supporting this operation develop after many trials and almost just as many errors.

Knowledge and skill are interconnected through experience in studio work. Students are expected to actively use, for example, solar factors, thermal conductance relationship, and structural ideas in creating new building enclosure details. In this process, one factor informs the other. Students learn not only about the concepts that work but how to put these concepts to work, situationally.

SIMULATION OF DESIGN IN THE OUTSIDE WORLD

The early precedents of the studio were professional offices. Students were apprentices learning from more experienced students and the master designer who ran both the office (the atelier) and the class-room (the studio). As educational systems became more formalized, this aspect of architectural education became a limited version of the

original set up. Students continued to learn in the context of design projects issued by the instructor and undertaken by peers in the studio; but this time the entire arrangement was artificial. The project was hypothetical. There was no real client. No monies exchanged hands or professional responsibilities discharged. Students pretended to do a realistic project and the faculty behave as if they may be clients and design critics at once.

Thus the goal of the present studio setting is to simulate, albeit in a very limited sense, the reality of the architectural design office. This is particularly difficult because the precedents that are available to the student in the classroom are usually devoid of the complexities and realities of the world of architectural practice. Clients, officials, financiers, and a host of consultants that normally define the parameters of a design are not present. Furthermore, the instructor who is the only conduit to the world of practice is often removed from practice due to academic responsibilities [5].

Nevertheless, the studio setting creates an environment within which students have to learn to think on their feet and respond intelligently to unexpected demands and uncertain design requirements. In spite of the best efforts of instructors who sometimes try to create a manageable world of design possibilities, other, imaginative design critics insist on admitting virtually any design issue, however irrelevant, into the criticism of a student project. This requires that student's address, during a review session, design issues that they were not prepared to address. As difficult as this test may be, the educational value of the experience for the student is invaluable. So long as students can escape some of the detrimental aspects of such experiences, they have a lot to gain. After all, this is not very different from what happens in the professional world of practice.[6]

WEAKNESSES IN DESIGN INSTRUCTION

There are three kinds of weaknesses in design instruction of the kind described above: motivational difficulties, insufficient instruction of the design process, and inefficiencies in learning.

In the case of "trial by fire" type of instruction, unrestricted criticism directed at students' work can become distracting and counterproductive not to mention demoralizing and destructive [6]. Students can pick up on the cynical aspect of such a relationship with faculty and may become disheartened about their own progress, even the particular career choice they may have made. When this approach works, it is done in a premeditated manner rather than in an ad hoc manner. Criticism is carefully delivered; and perhaps most importantly, students are coached about the rationale of the method and its benefits, beforehand.

Owing to its traditional focus on the product-based precedent in the design studio, students are often provided with little or no instruction on the process of design. When students analyze a precedent they start by understanding its physical characteristics and from there they move onto abstracting the conceptual aspects of the design. Nowhere in this picture is there any room for the analysis of process. Unless for some unusual reason the process is manifested in the overt physical characteristics of the final design, such as, building failure Precedents, students are generally uninformed about the process of design. Thus

the present form of design instruction does not support the teaching of process or design methods well enough.

In the situational model of instruction, where the relevance of general design principles, or specific design solutions, for that matter, hinge upon circumstance and chance, students are generally on their own to devise the means to get to the desirable end. Their search resembles groping for a needle in a haystack, since they do neither have sufficient experience to structure their solution domain (i.e., straws) nor sufficient command of their process to adapt it to the problem domain (i.e., clutching at). Analysis of precedents is utilized in structuring their design approaches. Derivation of principles of design occurs as a result of the happenstance or the personal interests of the instructor. When there is generalization from examples, improvisation and inducing from very small leads to a good deal of design inefficiency and confusion about instances and principles, result.

THE CASE METHOD

Overall purposes of teaching include a large variety of cognitive activities including thinking, sensing and perceiving, learning of facts and theories, reflecting, skill acquisition, applying rules and principles, solving problems, and so on. While there is a dose of each of these in any form of teaching, in professional education programs the principal focus of the effort is expended towards how to solve problems. This involves the hands on acquisition of problem solving skills and the body of knowledge that can support the application of these skills to a wide selection of problems. We saw in the earlier section how instruction methods geared towards this sort of educational experiences can be both liberating and limiting in certain ways.

The inclusion of such approaches in the educational environment of the university invariably proves to be beneficial to the intellectual climate of all parties concerned.[8] The general objectives of learning in the university setting actually provide many persuasive arguments for the validity of "learning activity in the presence of knowledge"[22 (pp. 218-219)]. This means that didactic forms of instruction invariably benefit from the inclusion of applications alongside of formal. This point of view, of course, is particularly cogent for professional education. In fact, for professional education to succeed, the core of the educational experience must consist of the representation of applications and actions in the profession. Thus, it is worthwhile to consider a broader sampling of these approaches to professional education.

A particular method developed at the Harvard Business School during the late 60s and early 70s provides a well-structured approach to the area of professional education: the "Case Method" [4]. In this approach, a problem-action context is established through cases within which knowledge and skill acquisition takes place. Students not only learn about the underlying principles but also the processes, which are related

to these principles.

The essence of the Case Method is presenting problems through past examples and the context of these cases documented in written form. The learning process centers on the discussion of cases in the classroom. It is paramount that students study the cases before hand and engage in debating the crucial aspects of each case in the class-room. In this way students learn about the principles of the domain through the cases or about knowledge through action. Schön[18], an early student of the method and an influential educator has aptly coined the term "reflection in action" to describe the process that takes place in the design studio which is akin in many respects to the Case Method.

Key roles that the instructor plays in this method are facilitating the discussion around a given case, selecting and presenting the case, and in some instances codifying and structuring the case. All of these are complex and little understood processes. The contributions of the work done at the Harvard Business School are most notable in structuring these activities and training instructors in the Case Method.

The successful discussion of cases involves several important goals. First and foremost the discussion section must function as a learning group. Next, there has to be high levels of student involvement. Finally, the instructor must play a role of facilitation and direction of the discussion without dominating it. This is achieved through a proper training of instructors and discussion leaders in the case method. This instruction is also structured as case-based learning (aptly so) illustrating the principles of leading successful discussions through case examples collected in the classroom [4].

The other key ingredient of the method, obviously, is the cases. Historically, cases used to consist of brief, at times, cryptic descriptions of situations, which then had to be elaborated extensively on subsequent stages of the instruction process. Currently, however, cases have justifiably become elaborate descriptions containing three indispensable aspects: (1) a description of the context that surround each case, (2) description(s) of the various stages of progression the case has gone through prior to its resolution as well as the solution, and (3) a description of the processes or methods that are relevant for these states. It is important to underscore the significance of the latter -- particularly for instruction in architecture -- where the cases used traditionally consist of only context and state descriptions, by and large, ignoring the process aspect.

The corpus of cases and their proper representation is obviously the prerequisite for any successful implementation of this method, regardless of the discipline of application. One of the very important services provided by the Harvard group is the documenting and making available to other institutions of a rich corpus of cases from which to teach business administration, in the classroom [4].

CONCEPTS OF CASE IN ARCHITECTURAL DESIGN: PRECEDENT

Now that we have considered architectural education in the general and case-based learning as a sympathetic pedagogic approach, let us introduce some terms that are critical for understanding Precedent-Based architectural education.

Let's start with the central concern of the field. An architectural problem constitutes a set of those that address the fulfillment of human purposes related to human occupancy, such as visual appeal, mechanical enclosure, or structural integrity. There have been many attempts at succinctly capturing these purposes starting with the earliest known treatise on architecture by Vitruvius [21]. This is an impossible task for obvious reasons and we are not attempting to undertake it. Rather we want to start with a tautology upon which to construct other more useful concepts.

What then is an architectural product? We know these products as buildings, landscapes, bridges and the like. The contemporary architect however produces designs for physical objects not the objects themselves. In this light an architectural product is the description of a potential solution to a given architectural problem.

How then is the architectural process related to the product? Similarly, the architectural process is merely a description of a procedure useful in solving a given problem. We have seen in the above discussion that both the process and the products of architecture have something to do with precedents. A precedent is previously developed product or process, which can be used to model new solutions in the problem domain of architecture. This is our lead into the discussion of architectural precedents, which is the codification of all of the information necessary to describe a precedent used in solving new architectural problems. A precedent-base, then, is the collection of instances or precedents usually codified in a manual or computational database. Finally, Precedent-Based learning is the dissemination and acquisition of requisite knowledge in a domain principally through the systematic examination of precedents encoded in a case-base.

CASE-BASED REASONING

Case-Based Reasoning (CBR) as a method in AI is considered to be the brainchild of Janet Kolodner [12]. Her work developed a computer-based system that could browse a repository of cases (recipes), find a match to the problem at hand (preparing a dinner) and adapt the recipe to the problem at hand (prepare a vegan dinner out of vegetarian recipes). The technique proved to be not only a powerful generative system but also one that would find broad applicability in other areas. For example, Mary Lou Maher [13] in building an expert system for the engineering design of high-rise structures used a case-base to initiate conceptual design ideas. Even more relevant to our topic here, Rivka Oxman [15] developed a case-base that assists designers in consulting design precedents. Her contribution is particularly salient since she used cognitively based stories that consist of design issues, concepts and form, as the indexing schema to underpin the browsing and matching mechanism of the system. Kolodner and associates [12] also emphasized the importance of this method in the area of building design through their work on ARCHIE, a case-based architectural design system.

As we indicated at the outset, while this literature is important, and there is a lot more of it than what's cited here[16], an extensive review of it is neither practical nor relevant to the current topic, which is Precedent-Based learning in architecture.

PRECEDENT-BASED LEARNING IN ARCHITECTURE

Precedent-Based learning in non-studio courses has a special place in the context of architecture education. Four forms of instruction, didactic, rhetorical, synthetic and experiential have an important place in the context of a full architectural education program. Lecture courses generally rely on the didactic method. Historical periods of style, for example, Mannerism, Post Modernism, Modernism, are defined and illustrated with examples. Students are told what each

of these is and are expected to remember what they are told and how they should use this information, in the future.

Figure1: Summary of instructional methods in architectural curricula

Seminar classes use the rhetorical method more prominently. They rely on the understanding of sample texts and images from a relevant domain in the context of debate and discussion. Larger principles are derived from these discussions in an inductive fashion, as opposed to the deductive style of lecture courses. Studio instruction focuses on the repeated practice of synthetic skills interspersed with criticism or rhetoric. The primary skill to be developed is, however, generative or synthetic.

Experiential instruction situates the knowledge to be gained into a simulated context provided by a precedent study. This complements the deductive or rhetorical forms of instruction used in architecture education. It balances the abstractness of the other forms and dovetails with the "Precedent generation" activities prominently in the featured design synthesis studio (Figure 1).

Precedents create a fertile ground for exploration of interesting subject matter and unique learning experiences. Students tend to follow the material with greater interest. Their cognitive faculties are not unduly taxed as they learn abstract material. A relevant Precedent study is always handy to connect abstract concepts to concrete examples. Furthermore, Precedent studies lead to engaging exchanges between students, between faculty and students, between students and the Precedent material. This exchange invariably leads to discoveries of new relationships and conclusions some of which have general implications reaching beyond the Precedent from which they are abstracted. Also, the number of Precedents that illustrate any given subject area seem to be surprisingly large. Our application of this method in the classroom started in 1990 in a course dealing with issues of decision-making in architectural design and then included

issues of ethical decision-making in design. In both instances, Precedent studies have abounded. Virtually any building design process if documented has important lessons for decision-making and ethics.

Our decade long experience with Precedent-Based learning leaves us with a distinctly positive impression of students' learning and course satisfaction indicators related to the overall approach.

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