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On the Role of Hypermedia in Architectural Design Education

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Teaching architectural design is not primarily concerned with presenting a body of knowledge analytically, but rather with influencing the way students act in a design situation. Previous design cases play an important part in this process, as they provide students with sets of objectives and corresponding solution patterns. Nevertheless, one of the main problems with using precedents in the design studio is that students take them rather as models to be copied than as starting points for their own research. To overcome this problem, the representation of design cases has to be improved. Our thesis is that in architectural design the structure of a case base of design precedents relies to a large extent on the various, and often conflicting, interpretations of precedents that are provided by architectural theory and discourse. Within a theory of design where exploration is the dominant strategy, we propose a method of using design cases and design theories in an integrated way. Through the use of hypermedia as a medium for representation of design cases, the process of looking for information can be based on the same metaphor as the design process itself.

Introduction

Teaching architectural design is not primarily concerned with presenting a body of knowledge analytically, but rather with influencing the way students act in a design situation. Learning by doing in the context of a design studio is widely accepted as the most appropriate method for this purpose. A design studio is a place of experience and of personal interaction; there is discussion and critique between students and teachers as well as among students. But a design studio also needs a theoretical environment, which is mostly provided by design precedents and by theoretical texts on design methodology, history of arts and architecture, and functional requirements.

Although design precedents and theoretical texts are regarded as important in most design studios, they never are a learning goal by themselves. A student's design is not evaluated on how much he has learned about precedents and theory, but on how well he was able to make use of them; transformation, not remembering, is the main objective. The media through which precedents and theory are accessed during the design process are therefore much more than just neutral containers more or less suited for memorizing information; every medium imposes a specific structure on the material it makes accessible, and as structuring is the first step of "making use" of information, the medium itself has influence on the possible ways of transformation.

In the following we will discuss the role of hypermedia as a new medium for the representation of theoretical texts and precedents in the design studio. First we will briefly investigate Marshall MacLuhan's theories on the relation between medium and meaning and their relevance in the field of hypermedia. We will then suggest a didactic concept for the use of precedents and theoretical texts in the design studio, and finally show how this concept can be used as a basic metaphor of a hypermedia system for architectural design education.
Media and Meaning

Marshall MacLuhan is best known for two publications about the role of electronic media, both published in the early sixties. The Gutenberg Galaxy (1962) and Understanding Media (1964). Although he dealt with electronic mass media in the first place and compared their impact to the cultural revolution that had accompanied print technology, his influence on the field of computer science is considerable. The Gutenberg Galaxy was published in parallel with the first attempts to regard a computer not as a machine, but as a medium. Doug Engelbart’s idea of the computer as an "augmentation of man's intellect" (Engelbart 63) and Ivan Sutherland's SKETCHPAD (Sutherland 63), which provided the basic concepts of interactive computing, both date from the early sixties. While those approaches mainly dealt with technical or personal aspects of interactive computing, MacLuhan pointed out the interpersonal, social aspects, and envisioned a cultural paradigm shift. According to Alan Kay, the feeling of being actively engaged in a revolutionary process was a driving force for research in the late sixties and early seventies (Kay 93). In his idea of the Dynabook, Kay referred directly to the first printed books that were small enough to fit into a saddle bag, an invention of the Italian printer Aldus Manutius. Much like the portable book had been the first step towards the age of enlightenment, the portable, networked computer was believed to be the first step towards a new electronic age.

The nature of this age was rather obscure. Marshall MacLuhan at least provided an analysis of the problematic side-effects of print technology. According to MacLuhan, "print technology fostered and encouraged a fragmenting process, a process of specialization and of detachment" (MacLuhan 67). Additionally, the predominance of print made the notion of "meaning" ubiquitous; attributing "meaning" to pictures and houses, to melodies and dresses is a common tendency of the age of enlightenment. (The German word for enlightenment, "Aufklärung", which means explaining, makes this even more obvious). In the history of architecture this tendency can be observed for example in the theory of "architecture parlante" and its influence on 18th and 19th century architecture. Victor Hugo's famous passage from Notre Dame de Paris — "The book will kill the building. That is to say, printing will kill architecture" — can only be understood in regard to this context. (Hugo 46).

MacLuhan rejects this reduction of phenomenology to linguistics (in the sense that every human experience can be fully represented by a text) and presents a radically different approach: for him "the medium is the message", because "every medium contains just another medium" (MacLuhan 64). What we observe as "meaning" is just the transformation of one medium into another. Electronic media have made this evident through their speed and overwhelming impact; there is no chance for decoding information into "meaning" anymore. For MacLuhan this is nothing negative: "Electric technology fosters and encourages unification and involvement." (MacLuhan 67) While the idea of "reading" the world in fact makes us unable to understand it, electronic media would allow for a holistic way of interaction again.

Reversing Victor Hugo's argument, MacLuhan points out the increased importance of the arts in a new electronic age. Just as higher education is no longer a luxury, but a necessity for the organization of production in the industrial age, the artist will be necessary for the formation and analysis of the structures that are brought about by electronic technologies (MacLuhan 64). Finally, MacLuhan seems to accept a sort of mysticism as one of the foundations of the new electronic age. He not only quotes John Cage ("The highest purpose is to have no purpose at all. This puts one in accord with nature, in her manner of operation."), but even the fourteenth century mysticist Meister Eckhardt ("Only the hand that erases can write the true thing.") (MacLuhan 67).

Which conclusions can we draw from these theories in regard to hypermedia? MacLuhan points out the dangers of both linear thinking and fragmentation that accompanied print technology, and he hopes for greater "unification and involvement" through electronic media. Hypermedia obviously allows for a less linear representation, but does it also allow for a less fragmented one? Can it actually encourage unification and involvement? Or does it rather encourage people to endlessly navigate through "universes of information" without actually getting involved?

These questions are of preeminent importance for the use of hypermedia in education. Using hypermedia as a tool for "information retrieval" will neither get students more involved in their subject nor will it improve creativity and problem solving capacities. For that purpose, the use of hypermedia as a "problem solving" or "problem exploration" tool seems to be much more promising. This means that the structure and the user interface of a hypermedia system have to reflect the way information is used in the problem solving process. This makes hypermedia systems more
domain dependent; while the process of "information retrieval" is similar in most domains, the process of "problem solving" is much more specific.

**A didactic concept for the use of precedents and theoretical texts in the design studio**

The problem of architectural design is a meta-problem: to find an appropriate set of problems out of the almost infinite number of possible ones in a given design situation (Archea 1987). It is comparable to "puzzle-making", where problems may be continuously redefined until a consistent set of problems and solutions is achieved (like, for example, in a cross-word puzzle). In architectural design a program's constraints do not lead to a fixed set of problems that can be solved one after the other. As the program is usually highly underconstrained, design is a process of finding an appropriate set of objectives and possible solutions patterns and then keeping this set as consistent as possible. Thus architects can be distinguished not only by their solutions, but even more by the choice of problems they decide to deal with.

More formally, design can be described as an exploration process, where an initially incomplete set of requirements is transformed into a final set of properties which defines the solution. The incompleteness of the set of requirements is the main point here. In contrast to the paradigm of design as a "big search problem" [Newell & Simon 72], the paradigm of design as exploration shifts the emphasis from goal-directed search in a state space to goal-oriented search in long-term memory, where start states, problem spaces and goal states are stored [Smithers & Troxell 90]. The strategy of finding a solution in a well-defined search tree is applied only in the final stages of the design process.

While it is quite obvious that design precedents constitute a large part of a designer's memory, the way this collection of precedents is structured is unclear. For design in general, a variety of structures have been proposed [Gero et al. 88, Maher & Zhang 91]. Our thesis is that in architectural design this structure is relying to a large extent on the various and often conflicting interpretations of precedents that are provided by architectural theory. This calls for the integrated representation of design theory and design precedents, where theory and precedents are complementing each other. Architectural design is always more than the application of a theory. On the other hand, at least novice designers will not be able to comprehend a design precedent without consciously recurring to some theory. (As a matter of fact, one of the main problems of using precedents in the design studio is that students take them rather as models to be copied than as starting points for their own research).

The main advantage of hypermedia as a medium for representing precedents and theory is its ability to link exhaustive representations of design precedents to various — maybe conflicting — abstract, theoretical concepts. As those concepts are likely to provide access to precedents of related interest, the exploration process will continuously lead back and forth between different representations. Thus, in such a system, the process of looking for information is based on the same metaphor as the design process itself.

**Supporting Design as Exploration in a Hypermedia Environment**

A hypermedia application based on this approach has to consist of two structural layers. The first layer is a collection of case materials. Precedents are analyzed and various media used to represent formal, functional, and technical aspects of these buildings. The second layer consists of hypermedia documents that represent theoretical discourses about architectural design. Viewed separately, these two layers are conventional hypermedia documents. Associated with each other through different link types, they form an integrated system (Figure 1).
To allow for the exploration process as described above, the indexing of the design precedents has to be done through abstractions of the theoretical texts, resulting either in terminologies or by simply relating a precedent to a theory node (descriptor - information item links in figure 1). In a "weak-theory" domain like architecture, this leads to conflicts caused by fuzzy or contradicting terminologies. As these conflicts result from the highly non-verbal characteristics of the material represented, they should not be eliminated, but made visible as distinct "language games". A more detailed discussion of this question can be found in [Kühn & Herzog 93]

Figure 2 gives an example of how a system based on this metaphor may be used in a design situation. It shows the relation between theoretical texts, represented by parts of their terminologies, and a set of design cases represented by diagrams. The example problem is to design a wide-spanned roof over a gymnasium on a rectangular site. The chronology of the exploration is indicated by the numbers [1] to [11].

The student may start by searching for items that are described by ‘roof’ within the concept ‘use’ [1]. By browsing through the retrieved items [2,3,4] he will find the example of a roof over a gymnasium with a span of 150 meters. The building is related to the descriptor ‘dome’ within the concept ‘formative idea’. The student may now ask for the consequences of the ‘dome’ [5] for the configuration of the design in the ground plan. In figure 2, a link indicates a positive association between ‘dome’ in the terminology of Logic of Form and ‘concentric’ in the terminology of Precedents in Architecture. [6]. (If it was not explicitly stated, this relationship could also have been found by searching for examples of ‘dome’ that occur both in the Logic of Form and in Precedents in Architecture.).

The cases for ‘concentric’ [7] prove to be inconsistent with the rectangular form of the site. The student may now look for similar solutions that are more appropriate to the site. By investigating the other configuration patterns of the concept ‘enclosure’, he might detect that a ‘double-centered’ [8,9] plan would be suitable, resulting, e.g. in two domes. As ‘double-centered’ is defined in the Precedents in Architecture as ‘two equally important foci located within a larger unit’ the student might now reason about how to define this larger unit or again search for similar solutions. In the latter case he will find that ‘double center’ is linked to ‘binuclear’ in the ‘addition’ concept [10]. Here he will find examples for the addition of two related elements without the need for a surrounding larger unit [11].

The student by now has arrived at two examples ([9] and [11]) that he can explore more closely. In addition to diagrammatic representations, he will find a variety of material, plans, photographs, video-sequences and descriptive texts. Due to the way he has accessed these examples, he has at the same time retrieved the theoretical background that allows him to make use of this information in a creative way.

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Figure 1. Information Structure
Conclusions

In spite of the growing availability of hypermedia technology, the expectations of the pioneers of electronic media are far from being accomplished today. Marshall MacLuhan's concern was to brake down the barrier of "meaning" that put itself between the mediation of the world and man; today electronic media have a tendency to become barriers themselves. Instead of quickly moving from one medium and representation to another, which can be regarded as one of the most important strategies of creativity, people may endlessly navigate through "universes of information" without actually getting involved in their subject.

We do not believe that this is a problem of hypermedia technology itself. The effect of getting "lost in hyperspace" is less a problem of getting lost in the physical space of a complex hypermedia.

Figure 2. Example of how the system may be used in a design situation
resource, but rather of getting lost in the conceptual problem of one's task. As a solution, we suggest making this conceptual problem of the task the very metaphor a hypermedia resource is based on. We have presented an example of how that sort of hypermedia system could be used in the field of architectural design education.

In this paper we did not deal with technical realizations. We have implemented a prototype system, using HyperCard as front end for the hypermedia-documents and are experimenting with possibilities of using NCSA Mosaic for the same purpose. The tools necessary to give the user the impression of being engaged in a problem-solving activity that goes beyond button clicking have to be further investigated. Designing these tools might be an artistic endeavor of the kind MacLuhan has predicted as a necessary step to overcome the limits of print technology.

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