The popularization and wide acceptance of computer technologies is changing the position and role of CAAD in architectural education and practice. The changing profile of architectural students with respect to computing leads to a reconsideration of priorities and structure in CAAD education. These are evident in the growing acceptance of the computer as part of the standard design instrumentation and in the shift from theoretical issues to hands-on experience in CAAD courses and exercises. As such changes can only continue to occur, probably at a faster pace, CAAD has to re-evaluate its position so as to anticipate the emerging patterns of computing in architecture and design. We can distinguish between three possible outcomes. The first is decentralization of CAAD and distribution of CAAD specialists to the other specializations in architecture and building. The second is concentration on theory and methodology and use of the computer as an instrument for verifying insights and hypotheses. The third option -the worst case scenario- is degradation to a supporting role, subordinate to the designer and the theorist.

1. The democratization of computing

One of the most striking cultural changes in recent years is the widespread availability of computer technologies. In the office and in industry most processes have been computerized and computers are been integrated in practically every kind of machinery. Coupled to the growing affordability of reasonably powerful computers, this has lead to an unprecedented extent in computer use and ownership, even for home and recreational purposes. Software is also becoming more affordable. General purpose programs such as text processors and spreadsheets nowadays cost a fraction of what they used to. Specialized professional software, including drafting and modelling programs, is still significantly more expensive but is bound to follow suit, as the number of users increases.

Perhaps the most important aspect of the proliferation of the computer in our society is its relation to popular applications, from entertainment to communication (Mitchell 1995). The Internet is a good example of the appeal of such applications and of the way they facilitate acquaintance with the computer in an informal and yet informative manner. The influence of such applications should not be underestimated. They are instrumental in changing computing from an arcane skill associated with asocial work patterns into a sophisticated but comprehensible ubiquitous infrastructure.

The democratization of computing has also been extended to education. Computer-based exercises and computer training is present even at elementary schools. This complements the rising availability of computers at home and allows children to become accustomed to and proficient in working with the computer at a very early age. As a result, we are experiencing a substantial growth in computer literacy. A large number of especially young people are:

- familiar with the ergonomics of keyboards, mice and all sorts of input and output devices;
- acquainted with the cognitive ergonomics of human-computer interaction whose affordances are becoming generally accepted;
- conversant with general-purpose and recreational software: text processing, simple drawing and obviously games hold practically no secrets to the younger generations.

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Computer literacy also extends to professional computer users. In architecture and design a large number of offices is substituting the drafting table with the computer. This means that, even though the intensive CAAD users remain relatively small in number, practically every designer in the office is exposed to working with the computer.

2. CAAD education

The democratization of computing and the consequent extensive computer literacy among students is inevitably changing the character and role of CAAD education. CAAD courses used to be the first and often the sole experience of an architect with computing before graduation. Despite their relatively short duration and restricted scope, we can claim that CAAD courses have so far served their dual purpose well:

1. exposing a large number of future designers to the possibilities of design computing; and
2. recruiting and training prospective CAAD specialists who would continue and augment CAAD research and teaching.

However, we one can also argue that CAAD education has until now failed to have a lasting and extensive influence on practice in the way issues like ecology have managed due to wider social exposure and appeal. Currently CAAD has a similarly suitable social context which makes CAAD teaching easier and more difficult at the same time.

The first change which obviously facilitates our work is the increasingly higher entry level of students. Very soon we can expect that there will be no need for including computer literacy in the CAAD curriculum. Future students will all have a basic knowledge of computing from school and home. Already a fair level of computer literacy is achieved in computer applications quite distinct from CAAD in academic life, from text processing to electronic library searches. Such activities equip a large proportion of the academic population with hands-on experience and a basic understanding of computers.

The higher level of computer literacy is already evident in many schools of architecture and has created the need to adapt CAAD teaching to the higher norms set by a more informed and involved practice and the improving profile of architectural students. A common reaction has been to shift emphasis from theory to practice. While in the past the ambition of every school of architecture was to produce its own drafting or modelling system, and later on to develop its own comprehensive design support system (Maver 1995), more and more schools are propagating their achievements in CAAD on the basis of products of the application of commercially available systems. On the Internet, for example, one sees many impressive architectural images and models made by students. We should, however, be aware of the fact that virtuosity in the use of drafting and modelling systems can improve only design efficiency which is quite distinct from design performance.

Another significant change in CAAD education reflects the lessening reluctance to integrate computing in design teaching. The proliferation of computers in practice has been leading to a growing presence of the computer in the studio and design courses. In many schools of architecture the computer is used alongside and as intensively and unquestioningly as the drafting table. CAAD specialists have responded to this change in either of two ways:

1. Cooperation with design teachers -usually in courses given by the latter- towards a complete integration of CAAD in conventional design teaching.
2. Abandonment of practical issues pertaining to the use of CAAD in designing to the design teachers and concentration on more theoretical aspects of computational design.

This dilemma is probably the central theme of our transition to a new position in the academic world. Being engaged in the transfer rather the development of new technologies, CAAD cannot probably aspire to a central role in the brave new world of the electronic era. The possibility of architects designing new, spatial interfaces for the computing infrastructures of the future is minute. The alien constraints of such problems, the irrelevance of specific architectural knowledge and experience, and ultimately the transience of the problems suggest a less than optimistic outcome of CAAD involvement. In the absence of new areas and expansions, CAAD is confronted with the problem of redefining its position and identity in architectural education,
research and practice, i.e. of deciding which of its current activities should be abandoned so as to preserve the remainder.

3. Design computing in the electronic era

It is ironic that CAAD is coming under pressure from the social and professional changes brought on by the advent of the electronic era. After several decades of evangelizing the practical and theoretical advantages of computational approaches, CAAD is being overtaken by the democratization of computing. We are turning from the custodians of an almost exclusive area to either theorists or technicians. In the emerging responses to such transformations we can distinguish three main approaches: decentralization, concentration on theory and methodology, and degradation to a supporting role.

3.1 Decentralization

The integration of computing in design teaching suggests that by distributing CAAD specialists to the other architectural and design specializations we can raise the understanding and acceptance of computational approaches and their relevance within each specialization. This approach has precedents in other engineering disciplines and can facilitate and accelerate the development of computer tools for specific design tasks. It entails, however, three main dangers to the integration of computing.

The first is that by distributing CAAD to the other specializations in architecture and building we may destroy the coherence of CAAD and of the underlying principles and methods. One could argue that it is too soon for such a change. CAAD is relatively young and too dependant upon technology transfer to have developed a comprehensive and stable corpus of widely applicable methods. On the other hand, the direct confrontation with complex, practical problems can be instrumental in redirecting the attention of CAAD to relevant, promising issues.

The same relative youth and methodological uncertainty are the main reasons why CAAD has so far failed to develop systems adequate for the solution of real-life design problems. CAAD research has often been criticized for its simplistic approaches which are ultimately inappropriate for practice (Maver 1987; Schmitt 1987; Koutamanis 1995). The acceptance of outdated rule-of-thumb and stereotypical solutions has impeded the analysis of design problems, the development of improved approaches and the exploration of powerful technologies for the implementation of these approaches. The scarcity of advances into areas such as scientific visualization which can rejuvenate CAAD suggests that we might be unable to grasp the complexity of architectural problems in other specializations and fail to link their structure to promising computational solutions.

The third danger is a reversal of the previous one. While CAAD has often been guilty of ignoring the priorities in other architectural specializations, these have also neglected to understand the possibilities and limitations of computational approaches. Especially in practice there is an almost total lack of knowledge of the history of CAAD. Some of the most attractive and promising ideas suggested by practice have been already analysed and dismissed in CAAD research (Maver 1995). Ignorance and mistrust of such results may impede integration of CAAD in other specializations, at least in the initial stages when the CAAD specialists may be put under pressure to reinvent the wheel.

3.2 Theory and methodology

CAAD is characterized by a fusion of technology and methodology. Theoretical issues are at least as important as technical ones and attract significant attention both in teaching and in research. Now that the technological component of CAAD is becoming common ground in architecture, we could focus on the theory and methodology of (computational) design. A corollary of this approach is that CAAD would remain the avant garde in the computerization of architecture, concentrating more on theoretical issues in teaching and reserving most applications for research.

Doubts as to the viability of this approach relate to the aforementioned methodological uncertainty of CAAD. Moreover, the traditional character of architectural theory may prove a
serious obstacle for the financing of research and its need for advanced computer technologies. Finally, concentration on theory and methodology may worsen the lack of cooperation with other disciplines for the resolution of practical design problems.

3.3 A supporting role

The worst case scenario is that CAAD specialists will become the computer technicians of architectural education and research, focusing on technology rather than design. A pattern that is emerging in design teaching is that CAAD specialists, especially the younger ones, assume a merely supporting role in design courses which employ computers. The design and theory teachers provide the problem and the methods for its resolution and the CAAD specialist guides the student in the use of suitable techniques, often at the very basic level of drafting and modelling.

Correspondences between this approach and current patterns in practice, should obscure that it dispenses with the methodological component of CAAD by subordinating it to the approaches it set out to refute or reform. It is doubtful whether this could lead to anything else but inability to use computing for the improvement of architecture and design performance. The only option that remains open to us in order to avoid this is to improve the performance, relevance and appeal of our teaching and research by integrating the specializations we need rather than been integrated in other specializations.

4. References


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