Claudio Cajati

A Fully Integrated Use of Available Media and
of Computer Technology for Up-to-date
Educational Tools in Architecture
Introduction

In this paper no general or specific forecast is made about what is going to happen in the next decade in architectural education. No extrapolation and projection in the future, through more or less sophisticated techniques, of plausible trends is attempted. Such an effort goes beyond the competence and intellectual force of the author.

That doesn't mean, however, that the author does not look forward to a precise and desirable future for architectural education - the central topic of the following considerations. Synthetically, the wished scenario is:

- highly specialized schools of architecture, with a restricted number of carefully selected students;

- CAAD-qualified teaching staff, with frequent and compulsory up-dating courses; management of schools of architecture committed to prepared and resolute persons, who do not resign themselves to an increasingly less central role of the architect in the design world;

- a stronger, institutional relationship, in education and research activities, between schools of architecture and architectural firms; that in order to confirm the particular identity of the university education - the wide range of research and training, continually based on valid practical experiences;

- a general attitude of teachers and tutors (putting aside, of course, 'teaching freedom') to foster and improve the students' interactive training, as daily and standard behaviour. Such a choice is compatible with the hypothesis of a 'Telematic Open University', including students being supplied with potent personal computers in their own homes. But we certainly have to confirm the irreplaceable role of direct human relations, of all forms of collective work that we adopt in our universities;
- a renewed proposition of traditional design methodology, in the primary meaning of «study of methods». That can give students a sophisticated and specified apparatus - methods, techniques and tools to optimize their own design training - rather than the prescription of some exemplary way of designing.

- an international unification of standards as for the whole range of computer aids, so that a real CAAD world market could be possible and operating, within a strategy of wider Computer Assisted Education in the schools of architecture.

Such a strategy certainly involves the underlying assumption of decreasing costs of computer facilities in the coming years, according to a steady trend. This way it would be easier for schools of architecture to equip themselves with equipments more advanced and complete than the ones usually available today, even in countries where CAAD was first introduced (see Y. E. Kalay 1986). But, more than to the level of costs, this perspective seems subordinate to a political willingness: to supply sufficient funds for better architectural education.

Will so many and such ambitious aims come to be? Probably not.

At any rate, what the title of this paper states and promises - a fully integrated use of available media and of computer technology for up-to-date educational tools in architecture - remains a desirable basic aim. Its realization involves a great, collective and protracted effort of organization, research, teaching, experimentation, revision and so on, for which a long period of time, something like a decade, would seem to be adequate.

**New occasions, permanent needs: some problems**

In the meantime, what is the situation in the schools of architecture?

Putting aside the differences between single countries, all the teachers and tutors seem to be involved in a singular contradiction:

1) on the one hand, we have at our disposal an advancing and fastgrowing computer technology and more and more sophisticated visual media, to a great extent developed apart from architectural requirements in education, research
and practice. In comparison with such an almost autonomous explosion, our teaching tools, our educational methods and strategies aren’t perhaps so dynamic;

2) on the other hand, these new technologies and media present limitations and ‘rigidities’, or sometimes even potential dangers. In the meanwhile, human traditional skills, media and experiences up until now constitute an irreplaceable inheritance of richness and complexity.

A sample case is the extraordinary development of digital image processing techniques. On the one hand, the philosophy of advertising, multiplying unusual mixing effects, fascinating changes and combinations of colours and textures, arbitrary image rotations and deformations, offers the possibility of a mystification: to divert attention from the defects of the project by means of spectacular images. On the other hand, it is certainly absurd to give up studying and applying the most advanced image simulation techniques, useful to bring the representation and communication of design solutions to the most realistic levels.

In general terms, the aim is certainly to integrate, not substitute, all the designing tools of the traditional designer with new visual media and with computer aids - CAD, CAD/CAM, computer graphics, image processing, computer vision - in a synergical collaboration between different abilities and devices (Fig.1).

This also involves a higher level of ‘Fluidity’ in man-machine and machine-machine interfaces. Above all, we need to develop and improve graphical input devices for syntionizing with the versatile, multi-tool, multi-technique ways of expression of the average designer. For instance, to go beyond the present limits of light pens and of digitizers; to lead the division between data input support and visual control support to some unity.

In addition, or at least as an alternative, it would be very useful to have at disposal scan-digitizers better in spatial- and gray-level resolution.

However, it is not the task or the pretension of this paper to give suggestions about the possible development and improvement of graphical media and
Fig. 1

MANUAL
drawings, spatial models, etc.

VISUAL MEDIA

NON MANUAL
photos, slides, films, videotapes, videodisks, olographies, etc.

COMPUTER AIDS
CAD
CAD/CAM
Computer Graphics
Image Processing
Computer Vision

output of computer aids as input of visual media

synergical collaboration between different abilities and devices

output of visual media as input of computer aids

output of the latter as input of the former

output of the former as input of the latter
interfaces. Such a task would be better carried out by the producers of computer graphics interfaces in collaboration with designers and architecture teachers and tutors. The emphasis of the following considerations is not on techniques, devices, utilities themselves, rather on their educational use.

**Training needs, design features, media-computer integration**

The proposed educational attitude - to foster and to aid students' interactive training - arises from a deep belief: the empirical and individual way of designing of each student (and then of each designer) must remain the context in which any educational aid, with and without a computer, plays its precise but limited role.

Moreover, manual and traditional skills, apart from computer and from new visual media, must be severely guarded, fostered and improved just because, made free from many troublesome, repetitive, stressfull steps in the design process, they may be brought to the highest levels possible. Likewise, the fastgrowing dimension of any kind of data bases never should 'stifle' the natural 'breath' of human knowledge processes with over-information. That could generate difficulties in finding one's bearings and in perceiving conceptual priorities and patterns.

On the contrary, the continuity and integration of all available media (manual - non-manual) must be educationally structured to meet the basic design questions.

It is therefore appropriate, at this point, to briefly mention some design features that justify looking in the direction of an integrated use of visual media and computer aids according to definite educational strategies.

A basic feature, steadily recurring in the majority of design methods, is the cyclical abstract-concrete movement, through gradual steps or leaps (Fig.2). This cyclical movement develops, for example:

- between abstract space relations and complex realized form,

- between synthetical form generation without analytical checks, and perfor-
Fig. 2
ABSTRACT-CONCRETE MOVEMENT

towards max abstraction

Lewis

RELATIONAL (abstract space - non-formal performances)

Topology

analytical way

GEOMETRIC

Typology

ICONIC

Building

synthetical way

FORMAL
(complex, realized architecture - context of the project)

towards min abstraction

Claudio Cajati - University of Naples, Italy
formance specifics-based drawings (that do not still – and never easily – lead to an adequate synthesis),

- between the real context of the architectural project, with its complete and high definition, and partial approaches, like topological, typological, volumetric, technological, as phases of a gradual search towards a final choice or some alternative candidate solutions.

In such a way, another basic design feature is introduced: the non-biunivocal performance-form interaction. This is a particular aspect of the well known 'polarity' what form is - how form works" (in Fig.3 an example about topology).

Either in abstract-concrete movement or in performance-form interaction, cyclical design paths are usually followed. A close network of interrelations between visual media and computer aids, which supplies a flexible and opportunely articulated 'training apparatus', answers these cyclical proceedings.

Then, in order to satisfy such design demands (here only two basic, exemplifying design features have been considered), there are many feasible directions for visual media-computer integration. Two at least appear essential:

1) The technical integration, that is the complete fluidity of interfaces in input and output operations. Through such an integration cyclical iterative input-processing-output loops, using different media (including CAD/CAM systems, olographies, videotapes, videodisks, etc.) may be usefully realized. That carries out the possibility of workstations in which 'real' image and digital processed image are related in an unique problem solving course.

2) The educationally structured integration during the single student's design training.

An educational integration

This is the most important field for different and new applications of
Fig. 3

THE NON-BIUNIVOCAL
PERFORMANCE-FORM INTERACTION
(examples about topology)

with different values
as for non-topological
performances

answering the same
topological pattern

FORMS

Form 1
Form 2
Form 3
Form n

A SAME
TOPOLOGICAL
PATTERN

---

recognizing how different
real architectural forms
realize a same topological
performance level

(partial identity in global differences)

---

exploring how a same
topological performance level
is satisfied by different
form syntheses

(global differences from partial identity)

Claudio Cajati - University of Naples, Italy
common media. Some simple proposals, among the many ones that any concerned teacher or tutor easily finds, may be mentioned.

It is appropriate to distinguish between:

1) educational tools as 'closed materials' in which visual media-computer aids integration is already produced and defined. Such materials are presented to the students as a particular kind of education-oriented products in lectures, seminars, tutorials etc.;

2) educationally structured 'design courses', in which integration between some computer aids and some visual media is decided, each time, during the students' training itself;

3) A particular, very promising combination of 1) and 2). That is to propose to the students, in some strategic points of their design solution search, 'educative stops'.

What does 'educative stop' mean? We know how much design is involved in a mixing of measured steps, puzzled stalemates, laborious analytical explorations, muddling rests, quick form productions often moved by partial awareness, and so on. In relation to such a labyrinthal, variable, iterative proceeding, the educational task in university training appears particularly delicate.

'Edcutive stops' can, therefore, perform a series of important functions: to integrate, to correct, to call into question or to remove a doubt, to provide more awareness of the project, to reinforce a design idea.

It is basic to confront the single student's design work, free to develop with its own inner logic (or lack of logic), with a series of check moments and comparisons. This may be, above all, realized by showing possible alternatives, differently motivated and interpreted, along the same design course. As for the topic of this paper, all that is possible, in adequate efficient ways, adopting procedures based on the tight computer-visual media integration (either in data input or output, in cyclical loops).

The whole activity in conformity with this direction involves the institution, within the schools of architecture, of a particular system of data bases. We
could define it a 'Visual Bases Machine' ("visual" for going beyond the alphanumerical data). That should include either integrated products or 'tree' documents, from which new research and teaching syntheses might, in their turn, be synthesized.

Its periodical updating should of course include the storage of all the research and education materials (photos, slides, films, videotapes, videodisks, etc.), classified according to given precise criteria and accessible through clear keywords and visual symbols. Likewise, specific attention should be paid to the systematic production of research results in the form of visual educational tools, ready for becoming part of the Bases Machine.

Not only should the university itself be involved in such a production; architectural firms could collaborate with schools of architecture, especially elaborating videotapes about the complexity of daily practice, outstanding architectural trends, new sample solutions, case studies etc. (see T.W. Maver 1985).

Some examples

Let's try to mention some possible subjects for these videotapes:

- analysis of buildings' constraints and potentialities, using dimensional, topological, morphological and technological viewpoints, in order to choose new functional destinations and the consequent, best architectural modifications;

- description of typical sequences of the inclusive cycle of architectural work, like design - building - maintenance - modifications - maintenance, again - modifications, again - functional re-destination or demolition - indications for re-design - and so on;

- historical studies according to two 'reading axes': the syntagmatic (unity within a single building) and the paradigmatic (differences and analogies among buildings), so that stylistical, typological, technological viewpoints may be methodically and minutely assumed;

- comparative analysis of buildings' prospects, as for their textures and
grains, through the techniques of pattern recognition (see D.H. Ballard, Ch.M. Brown 1982). That in order to explore the geometrical and mathematical roots of architectural qualities we usually recognize by synthetical insight;

- description of sample cases in which clear differences between designed and expected performances of a building project, and real performances of the finished building are noticeable;

and so on.

All these subjects - and many others that could easily be drawn from daily university teaching and research work - are appropriate to verify the aforesaid considerations about the kinds of visual media-computer aids integration. That is, the promising combination of 1) educational tools as 'closed materials' and 2) educationally structured 'design courses'; the role of 'educative stops'.

Following are three examples, in order of the students' curriculum: from the beginning of undergraduate training, to the graduation thesis, to some postgraduate specialization.

**Example 1** (Fig. 4). Let's imagine an educational videotape dealing with an **illustrative case** of design process - a completed but not necessarily realized project - previously developed within the school of architecture itself.

(Such a videotape must of course be designed and realized not at the end of the process, but at the same time as the design work in progress: which is actually possible only by the basic mediation of a 'scene arrangement'. Moreover, the proposed design process will certainly involve the use of some computer aids. Therefore, the ideation and realization themselves of the aforesaid video constitute, before its real educational use, an example of integration among different visual media, and between these and some computer aids.)

For students at the beginning of their undergraduate curriculum the teacher or tutor could use the videotape in the following way:

a) to present to the students, for their approach to the design exercise, a conceptual starting-point: the 'slogan' of pursued objectives and followed criteria in the proposed illustrative case;
Fig. 4

Beginning of design training

- Pursued objectives and followed criteria in the proposed illustrative case
- First ideas, sketches, notes etc. in architectural terms
- Solutions drafted by students

Choosing one comparison criterion for either intuitive appraisal or computer aided check

And so on, analogously...

Teachers and tutors

- Giving a conceptual starting point
- Encouraging interpretations
- Showing the videotape
- Comparing illustrative case's and students' solutions
- Identifying overt comparison criteria

"Visual Design Machine"

Educational videotape dealing with an illustrative case of design process

Claudio Cajati - University of Naples, Italy

141
b) to encourage some first ideas, sketches, notes interpreting the conceptual input in architectural terms;

c) to show the videotape;

d) to compare the illustrative case’s solution to some of those drafted by the students. That could be realized, for instance, using slides to be projected in parallel by means of coupled projectors; or, through more sophisticated devices, memorizing them in the same computer graphics system with the possibility of presentation on a high resolution screen divided in many ‘windows’.

That should give a first shock about the great freedom degree available to designers, even when following and interpreting the identical basic aims and criteria in their projects;

e) to identify overt criteria of comparison among the selected solutions, and to choose one of them for which either intuitive appraisal or check by proper computer aids is possible.

And so on, analogously.

Example 2 (Fig.5). Towards the end of the undergraduate curriculum, it may be appropriate to propose to the students an opportunely structured videotape divided in two parts:

1) presentation of a reference solution (e.g., an executed residential building), drawn from the ‘Visual Bases Machine’ or supplied by some architectural firm;

2) explanation of the actual performances of the executed project, in comparison with the expected and designed ones, including the changes made, later on, by inhabitants themselves (or by some other designer) when adapting the building to their real needs.

The educational exercise may be organized in the following way:

a) to show only the first part of the videotape;
Fig. 5

Beginning of design training

encouraging to describe them through any media

through manual and/or computer aided media

students’ training proceeding

inviting to re-design proposals

showing the videotape - first part

individualizing qualities and defects

modifying the proposed solution

showing the videotape - second part

discussing differences

between real modifications by inhabitants and those previewed by students

Teachers and tutors

a videotape in two parts

presentation of a reference solution e.g. an executed residential building

2

explanation of actual performances in comparison with the designed ones

Claudio Cajari - University of Naples, Italy
b) to invite and encourage the students to describe through any media qualities and defects they see in the proposed reference solution; consequently, to modify it with and without computer aids in any sequence, e.g.:

- immediate manual sketches then memorized, by means of a scan-digitizer, within a computer graphics system and maybe again, by plotted output, used as matrices for further manual, interpretative manipulations;

- input of the solution to be modified, again through a scan-digitizer, in definite computer graphics processes; in order to obtain plotted drawings of a concluded solution or – as in the former case – only matrices for further manipulations, in their turn manual or also, later on, computer aided;

c) to show to the students the second part of the videotape; to discuss with them the meaning of chief differences between the real modifications made by the inhabitants and those previewed in their own solutions;

d) to invite the students to re-design their proposals, paying attention to those design qualities, seemingly overt in their drawings, but dependant perhaps on people’s approval.

Example 3 (Fig.6). At the level of postgraduate specialization, it becomes basic to verify the design skills and experiences in relation to the real professional context. It is particularly important to simulate some chief interactions between the designer’s task and the motivations and behaviours of other protagonists of the designing-building process (managers, constructors, surveyors, etc.) in terms of precise restraints or pre-established decisions.

In such a context the visual reference medium is a videodisk, produced by university educational staff together with some of these other protagonists (videodisk, and not videotape, as it assures a greater interactivity). This has either to describe a conceptual model of design adaptations for meeting the demands from others operators, or to show definite examples of design changes (in costs, typologies, building systems, materials, etc.).

The postgraduate thesis project might deal with either an improvement of the aforesaid model, or a new architectural application. The high interactivity
Fig. 6

- Visual Bases Machine

- A reference videodisk

- Study of the model
  - Improvement of the model

- Study of the exemplification
  - A new architectural application

- Simulating interactions between the designer's task and the behaviors of other protagonists of the design-building process

- Integration and personalization

- Improvement of communication structure

- Conceptual model of design adaptations for meeting demands from other operators

- Definite examples of design changes

- Proceeding of postgraduate thesis project

Claudio Celetti - University of Naples, Italy
of videodisk technology permits to turn such contributions into an integration and personalization of the reference videodisk.

Should the postgraduate student enter the university educational staff, the thesis might moreover deal with a better communication structure of the videodisk itself. This way a further contribute to the patrimony of the 'Visual Bases Machine' would be available.

Conclusion in the form of an opening

The development of new visual media and computer aids, and their continuous improvement, now quickening their steps because of commercial stimulus, appear aggressive and irreversible.

There is no automatic promise, no automatic danger, for university architectural education, from this. The growing impact on our jobs as teachers and tutors will be useful if it finds us methodologically prepared, with articulated experiences and programs.

A lot of our educational work will probably change into an ordered and careful arrangement of sophisticated, oriented information materials. More and more we will have to aid students' training through such educational tools: structured, realized and proposed by ourselves or with our collaboration.

An important and enrapturing task, indeed, for the next decade.

References


Alan H. Bridges, "Computer Aided Architectural Design Education", ibidem,
pp.327-332.
