DIDACTIC INTERACTIVE TOOLS IN ARCHITECTURAL EDUCATION: A CASE STUDY

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**DIDACTIC INTERACTIVE TOOLS IN ARCHITECTURAL EDUCATION: A CASE STUDY**

During the closing address of ECAADE '91, Professor Krammel told us that in the next ECAADE Conferences, papers should be related to Architectural Education. In our paper we present a proposal based on the use of new didactic interactive tools, mainly multimedia and hypertext, the combination of which is sometimes known as hypermedia.

**Why is this necessary?**

Traditional architectural education took for granted the separation between the teacher in his chair and the students at their desks. As a result, books, notes and other didactic materials were received passively by the student, who had no choice whatsoever in the matter.

But one image is worth more than a thousand words, and graphic didactic materials have been in use throughout history. And it is hardly necessary to point out that the use of such visual tools is all the more justified in the teaching of architecture.

The arrival of photography enabled us to have exact reproductions of buildings and details of construction. Slide projections in class meant a clear advance on traditional drafts and sketches drawn on paper or on the blackboard. Didactic audiovisual material represented a similar step forward, but the systems in use at present, which are based on slides, have certain drawbacks. They can only be viewed one way, the attitude of the viewer is completely passive, to produce them requires a great deal of time and effort, and there is little flexibility for introducing changes and adaptations.

New teaching aids based on these didactic interactive techniques are being explored. According to S. Ambron and K. Hooper, Interactive multimedia in Education "are a collection of computer-centered technologies that give the user the capacity to access and manipulate text, sounds and images. Just as word-processing programs today enable users to integrate texts and graphics, multimedia programs in the near future will enable users to have access not only to libraries of text documents but also to resource banks of music, sound effects, speech, still images, animation and movies. In addition, multimedia users will be able to manipulate this lexicon of material and add their own material."

This approach does not exclude the teacher’s role, but allows him to avoid tedious and repetitive tasks and to dedicate more time and effort to tutorial and personalized teaching. Computers can help, and in some cases substitute, the teacher's lessons in topics where the visual component is of prime importance.

By contrast to classic audiovisual aids, these materials permit easy and almost automatic adaptation and evolution. This naturally requires a good, intuitive and
friendly user interface. The ideal would be to reach the stage that the Kodak Instamatic cameras did in the early sixties. This could be described as an Instamatic User Interface.

At the present moment several multimedia systems are about to come onto the market amid fierce competition to become the universally accepted standard: Digital Video Interactive (DVI, Compact Disc Interactive CDI), developed by Philips; Apple's QuickTime; IBM, with Multimedia; Compact Disc TV CDTV) by Commodore; Video Disc, and so on. There are also systems developed by Sony, Canon, Panasonic, etc., as well as those arising out of agreements and joint projects between companies. Some of these do not seem particularly promising, whereas others will soon be making a great impact. In the end, as happened with video, one system will predominate. Amid the present confusion, some people go as far as to say that we are embroiled in a "media chaos".

Our project can be applied to many different aspects of teaching. The case that we present here deals with the process of constructing a reinforced concrete building. What we mentioned above about the use of graphic didactic materials in architecture is particularly relevant in the teaching of Building. There are also various other reasons why we chose to work on this particular subject.

In Spain, over 70% of non-industrial buildings are constructed using reinforced concrete. There is therefore no shortage of examples and information, both graphic and written, which can be consulted.

On the other hand, a good working agreement was established between our team and the staff teaching this subject. The lecturers involved offered to act as advisors, and allowed us to perform experiments with their students. They also gave us access to their archive material, both documentary and graphic. And last but not least, a textbook was available which helped us greatly and could be used for reference purposes.

We began work by following the progress of a building from the time when construction started, taking a series of slides and videos which follow closely the different phases of the building process. This is explained in greater detail when we describe our working methods.

We bear in mind the need to pay attention to the visual aspects of architectural education. When teaching Building, many examples should be presented, both of building constructed and of details of design. One problem which has often been stated to occur when building processes are being explained, is the need to bridge the gap between the explanations and sketches given in class, and the reality of the building site.

In Spain, the usual way of confronting this problem is by visits to building sites in the company of a teacher. Such group visits are not particularly profitable. Some students—usually those standing closest to the teacher—may learn something but it is likely that those further away will be wasting their time. Nor do personal visits by individual students prove to be sufficiently instructive. It is difficult to schedule these
visits for the time when some interesting process is being carried out, and the lack of guidance makes the student unable to take advantage of the opportunities for learning which "in situ" visits have to offer.

In our opinion, these new interactive didactic materials based on the latest audiovisual technology are capable of overcoming the limitations of on-site visits, as we have explained above, by replacing and even improving on them.

We stated above that this project is not intended to replace the teacher. Nor is designed to be a substitute for textbooks or site visits. But in the case of the latter, as well as overcoming the obstacles mentioned above, various other advantages come to light. Chronological follow-up of the building process can be backed up by text and bibliographical references which can be visualized at will, side by side with the images. Menus or cross-references allow the student to consult other subjects of relevance which may occur to him while he is studying a concrete case. Thus one image may prompt us to revise a subject studied earlier on which we feel shaky, or to look up some piece of information which we wish to be reminded of. Lastly, although this is a complex issue which will be the subject of a future study, it is also possible to choose the means by which the materials are consulted. For example, the textbook is developed systematically, whereas the building process in our project is followed chronologically. The advantage of being able to choose between these methods is obvious, and other possibilities would widen the scope still further.

Fig. 1 Display of the evaluation module, choosing the right answer
We should now like to draw attention to another interesting aspect. We base our project on a real building, one which is not ideal from the constructive point of view. In reality, no ideal buildings exist, only buildings which solve some aspects of the problem very well, and other aspects less well. For this reason, in each chapter of the project we can call upon the example of different buildings in which these concrete details find their best solution.

To this potential for broadening and improving the range of material available, we can add the advantage of a personalized approach to learning. Our method allows us to put on display, complete with sound, animation and replay facilities, consecutive steps in the construction process. The student will have control over the pace of browsing and so on. At any given moment, he can call on texts, databases, etc., and review topics which he has not fully understood. The computer will display images, video and sound.

These real images can be complemented by plans and sketches of the same details of construction on paper, illustrating the relationships between different elements, and even including instructions for performing certain operations.

Lastly, the student can evaluate his own knowledge of the subjects studied.

Fig. 2 Display of the evaluation module, choosing the right image
These new technologies function like a spider's web, with nodes of information and multiple access routes to that information, and thus allow the student to relate everything he learns to other aspects of knowledge, and even to facts which may be new to him. This encourages the student to develop the ability to relate different aspects of his studies to one another, and to synthesize information.

**Working procedure**

For the purposes of this study, we formed a group of six students in the third year of their university studies. They were directed by the authors of this paper, under the guidance of the lecturer in Building and the Department of Fundamental Education, so as to establish the basic criteria for governing the way the student-computer relationship should be conducted. This team took photographs and video of several steps in the construction process.

Regular meetings with the teacher of the subject enabled the team to produce definitive scripts on each topic, choose images, and relate different aspects to one another and so on.

We used the following equipment:

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Macintosh 11 ci; slide scanner; video capture board</th>
</tr>
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<tbody>
<tr>
<td>Software</td>
<td>HyperCard 2.1; Macromind Director 2.0; Adobe Photoshop 2.0; Adobe Premiere; QuickTime; Mac Recorder</td>
</tr>
</tbody>
</table>

We originally intended that this application would be finished by October 1992, but we now see June 1993 as a more realistic deadline. At the present time, the HyperCard organizer is being developed, which is explained below.

It is hoped that the system will be used by students of Building in the academic year 1993-94.

Our intention is to let one group of students use this method, while another group studies the same subject following the traditional methods, so that the results can be analyzed.

**Information technology**

The terms hypertext and multimedia are not new, and forms of technology already exist which control text, images and video. We had already been working with Macintosh computers, on which we had developed some hypertext structures with HyperCard, but it was the appearance of QuickTime technology for Apple computers which enabled us to envisage the possibility of developing educational programmes which integrated hypertext structures with multimedia technology.
Hypertexts present the typical tree-structure for storing the information needed. Access to this information is easy and intuitive, but its manipulation (change, canceling or incorporation) is more difficult for the layman. The aim of this study is to develop a structure which is easy to manage for both types of user: the teacher who edits or modifies it, and the student who consults it without altering it actively. We hope that this will be of use not only in the particular case we have in mind, but also in similar cases. The teacher may introduce and modify information through the familiar structure of files and subfiles of the Mac operation system. The professor who wishes to manipulate the information thus has no need to learn to program in HyperTalk, or to be acquainted with HyperCard structure, but can do all he needs using the Mac "Finder". Access to information, on the other hand, is gained via HyperCard, which has an interface which is intuitive and easy to use.

It is obvious that, from the teacher's point of view, the most important aspect is the selection and input of digitalized data (ASCII texts, PICT's images and videoclips). The structure into which this is assembled is less important, which leaves the door open to future developments based on other systems (DVI Digital Video Interactive, CDI Compact Disc Interactive, Multimedia, proposals from the Kaleida project, etc.).

On the other hand, bearing in mind the project in hand, we must point out that QuickTime enables us to overcome some of the classic limitations of HyperCard, making it possible to incorporate colour, animation, etc.

Our project therefore has the following objectives:

1. To create structures in information technology in which the chief participant is the person teaching the subject. We should thus try to provide him with programs, etc., which are easy and convenient to use, for which he does not need to learn how to program.

2. To allow for adaptation to future needs. To facilitate the making of changes and the addition of new information and structures.

3. To make the input of new information easy, without necessitating knowledge of computing beyond simple navigation using the Macintosh "Finder".

4. As a more long-term objective, to form groups of student participants to learn enough of the writer language to work in teams under the guidance of professions, developing didactic material for themselves and their fellow students.

The HyperCard program enables us to develop a structure which functions as a system for information management, using files to classify material. Each file constitutes a chapter, within which there may be further chapters or other information. The information basically consists of texts, still images (compressed Pict's) or sequences (movies). Another possibility offered by integral QuickTime technology is that of compressing images in order to obtain more illustrations in a smaller computer space.
Fig. 3 Typical user interface based on Hypercard

The main structure which our project develops is a system of classification for files which follow the different stages in the chronological development of building work. Into this we insert both static and dynamic images taken during the building process.

Modifying the structure of the thematic trunk– is as simple as erasing a file, adding another, changing a document within the file, or adding a new document to it. This can all be done by professors or students without specialized knowledge other than how to manage the files in the Mac “Finder”.

At the risk of repeating ourselves, we should like to stress once again that the structure in question is an open structure. As we have already indicated, the most noteworthy aspect of this type of project is the digitalization of images, of the written texts, and of the relationship which is established between them. However, all the images, videos, texts, etc., are independent elements which are valid in themselves. In the future, when standardization of multimedia technologies comes about, even if HyperCard is no longer a valid instrument, the work we have done on this project will still be valid, as the essential documents are worthwhile in themselves, and not only within the framework of this assemblage.

Hypertext structures can in turn be open structures, as discussed above, or closed structures in which their value is subordinated to the program in which they have
been developed. We can thus develop structures in HyperCard or Macromind Director, using tools proper to these programs (transitions, degradations, superimpositions, etc.) to carry out an explanation. Even though the illustrations maintain their basic value, these structures remain closed within themselves, which at the present would tend to rule out the possibility of exporting these developments.

The results obtained using these closed structures is more direct and attractive, and makes a greater impact. Moreover, at the very start of the project they may prove more effective, and so we have not discarded them entirely.

Furthermore, these attractive results allow us to attract the attention of professors from other subjects, and show them how these technologies can be a basic aid in teaching their own subjects.

**Development of the project**

In order to carry out this project, we must distinguish various types of task which can be performed independently and at different times.

First, there is the copying and classification of material. On the one hand, photographs and slides must be taken and videos made. This is done by means of periodic visits to the site. On the other hand, we need to consult the material supplied by teachers of this subject. It will also be necessary to revise existing sources, both bibliographies and programs already in existence.

Part of this phase is preparatory to the actual computerization of material. Other programs are studied, and the advantages of hypermedia technologies are analysed, so as to be able to plan the thematic structures with a view to exploiting these technologies to the maximum.

The stage of collecting and classifying material (digitalization of photographs, slides and video), both new and old, is being performed largely by students, who follow the norms laid down in the first project meetings. These data are taken and noted down by students, who then work on the textual documents relating to the images.

It was this stage which roused the most interest among the students. As the results were immediately visible, they could appreciate the usefulness of what they were doing.

**Development of the HyperCard system**

The central structure of HyperCard as a manager of external documents (compressed Pict's, QuickTime movies and texts) classified according to files, has been developed by the authors of this article. The ease with which the teacher can manipulate the system tends to be inversely proportional to the simplicity in terms of computer technology, which usually obliges the programmer to create a powerful structure.
We considered whether some of the students collaborating on this project should learn HyperCard, but it seemed preferable that they should work with Macromind Director because the attractiveness of the results would help stimulate their interest.

**Development of Macromind Director branches**

This phase was developed entirely by the students after a few session in which they were taught the program. Our hopes that them would be interested were fulfilled at once, and when they saw the results they were obtaining their interest mounted. They took the initiative in asking their fellow students to try out the parts which were already complete, in order to test their reactions to the program.

They were encouraged to help design the user interface, and we agreed to accept their ideas providing that it did not involve great difficulties. At present no rulebook exists for the setting out of hypermedia programs. They chose a colour Code rather than more traditional methods involving the use of, for example, arrows.

We are aware of the dangers which this implies: in the first place, the use of colour monitors is obligatory; and secondly, we are moving away from the better-known methods of navigation around hypertext. In any case, it seemed preferable to run this risk if this would help to rake the work less mechanical and encourage the students to take the initiative.

![Fig. 4 Sample of display of a animation created with MacroMind Director](image)
On the other hand, the format of the screen rules out the possibility of using it with Classic Macintosh models, and many of its own images are displayed in colour. The appearance of colour screens at low prices, even in notebooks, is imminent.

**Conclusion**

The application of interactive didactic material based on hypertext and multimedia techniques can provide tools which are extremely useful in the teaching of architecture.

Their use can save the teacher certain types of work, allowing the student to study independently and leaving the teacher with more time for personal attention, seminar work, etc.

Students can learn rapidly and effortlessly how to use the systems, and can evaluate their results.

Among other advantages, such aids can help students to understand the reality of the construction process.

These tools should be developed by professors of Architecture.

They can be created without knowledge of programming, or with a minimum of expertise.

The period needed to create and adapt these programs will allow time for the multimedia standard to be established and propagated; by the time they are ready, it is hoped that all students will have access to computers.

These systems will allow access to the main information, and to other reference material related to the different aspects of the former. In the future we should like to study the possibility of using different indexes when calling up information.
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