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The critical usage of information technology at the School of Architectue of the Federal University of Minas Gerais in Brazil

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The critical usage of information technology at the School of Architectue of the Federal University of Minas Gerais in Brazil

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Abstract

This paper describes the work carried out in Lagear (the Computer Laboratory at the School of Architecture at the Federal University of Minas Gerais, Brazil). Lagear was founded in 1993 and since then much teaching and learning has been conducted there. Course modules, such as 'Environmental Comfort' and 'Perspective', took place in the Laboratory, where the students were required to use computers; other subjects, such as 'Computer Graphics' and 'IT Applied to Architecture' were entirely focused on the use of computers in architecture.

A critical assessment of students' experience shows that there is a difference between teaching 'Computer Graphics' and teaching 'IT Applied to Architecture'. The first one refers to the use of CAD software to represent, geometrically, the object of architecture; the second one is the use of computers as tools for thinking about architecture. Using examples from students' work this paper demonstrates this difference by tracing Lagear's experiences, from using computer resources as representative tools, to using the computer as a creative instrument with which to think. An evaluation of the traditional use of computers in architecture is offered, together with indications of the directions found to be the most interesting in the learning process. Figure 1 - an investigation into CAD modelling and self-image - illustrates Lagear's students non-conventional approach to investigating the use of computers in design.

Keywords: architecture, CAD, design methods, IT, meta-learning, student learning



Figure 1 CAD modelling and self-image by Maurício Leonard

Introduction

Lagear is a computer laboratory for teaching architecture at the School of Architecture at the Federal University of Minas Gerais in Brazil. It was founded in April 1993. At its inception there was an intensive training period to prepare a team of lecturers together with two employees, both architects, and two trainee students in order to give support to future users of the laboratory. This training period was led by Professor Edward Ng from Sheffield University, and focused on the creative possibilities of the use of different software packages. In these workshops all participants were given a task to be completed using different software packages, including word processors, two-dimensional image manipulation packages, three-dimensional modelling packages and also animation packages; this was in order to investigate and experiment with a broader range of tools. In this way, the participants had informal contact with a number of the essential aspects of each application. From this it was noticed that different software packages offered different ways of solving a problem. In other words, as a creative tool any software package influences the final results according to its possibilities and limitations. Therefore, if one has knowledge of these different 'tools' it becomes possible to choose one, or a combination of them, that best suits each specific activity.

Some experiences of teaching in Lagear

The laboratory facilities have been used for a range of courses and modules. In this paper, four uses are described (based on 'instrumental disciplines'), together with their critical evaluation. The aim of 'instrumental disciplines' is to allow the students to obtain knowledge of some fundamental information required by architectural practice - for example, this could be a basic knowledge of environmental comfort and representation techniques.

The 'sun's effects on the environment': a module of the course 'Environmental Comfort'

In the module 'the sun's effects on the environment' the students used computers to build an urban environment model and also

to analyse the simulation of the 'sun's trajectory' for the model over the course of a year.

The strategy used to teach this module of Environmental Comfort (Santos, 1995) began by introducing CAD techniques, which had as its main aim the calculation of the 'sun's trajectory' through the urban environment. In this case 'Modelshop' was adopted due to its ease of learning and also its capability to allow a direct analogy with the usual solar charts. At the end of the first lecture the students were able to build a block model of the landscape levels (Figure 2) and the urban environment (Figure 3) which they were studying.

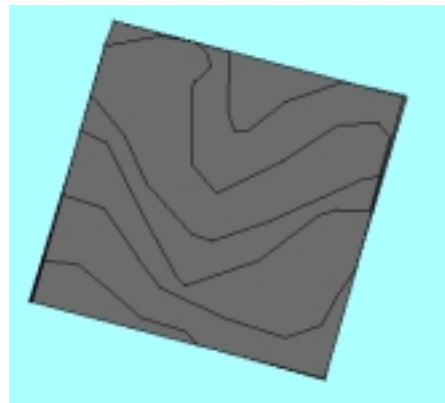


Figure 2 Landscape modelled in Modelshop

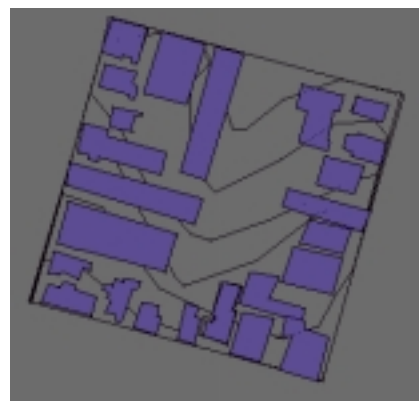


Figure 3 Building modelled over landscape

The second lecture was used to explain the sun chart, as well as azimuth and sun altitude angles; the students were encouraged to play with some basic dates, such as summer and winter solstices and equinoxes, in order to assess the effects of the sun during the year. The model could be viewed with its shadows in plan, perspective or elevation (Figures 4 to 13).

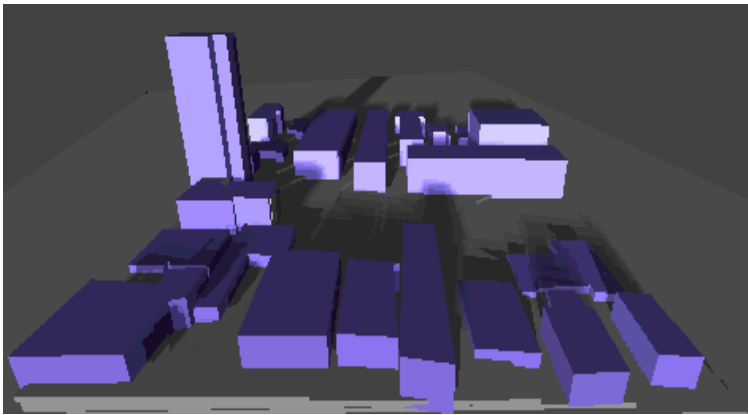


Figure 4 An example of an urban environment with shadows simulating Summer Solstice at 7:00 am

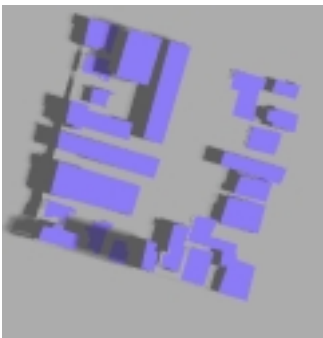


Figure 5 Summer Solstice 8:00 am

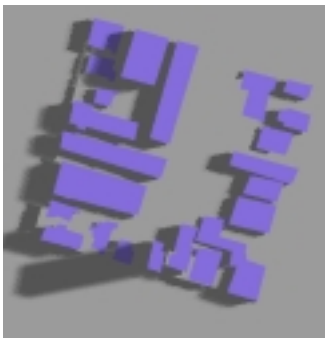


Figure 6 Equinox 8:00 am



Figure 7 Winter Solstice 8:00 am



Figure 8 Summer Solstice 12:00 pm



Figure 9 Equinox 12:00 pm



Figure 10 Winter Solstice 12:00 pm

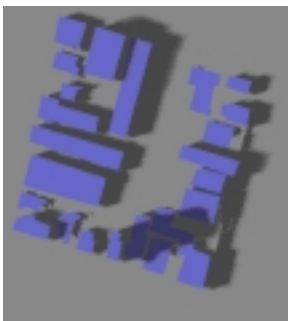


Figure 11 Summer Solstice 15:00 pm

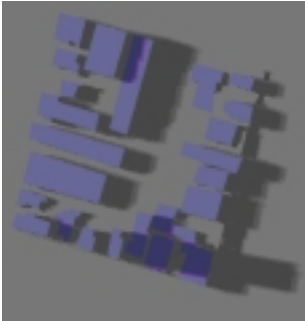


Figure 12 Equinox 15:00 pm

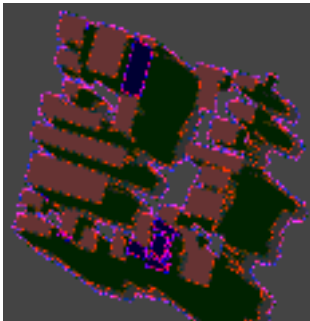


Figure 13 Winter Solstice 15:00 pm

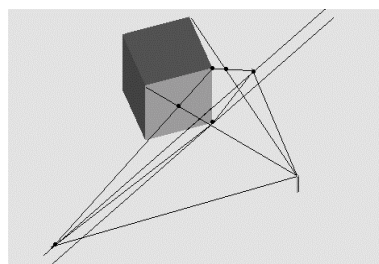
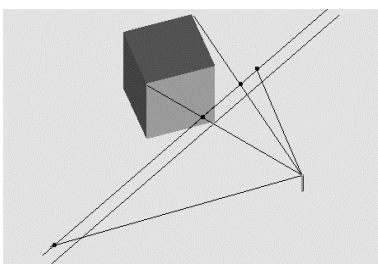
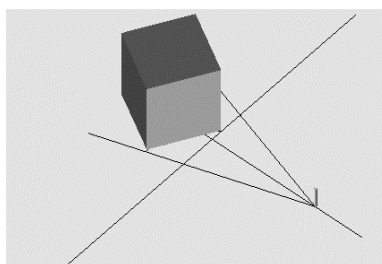
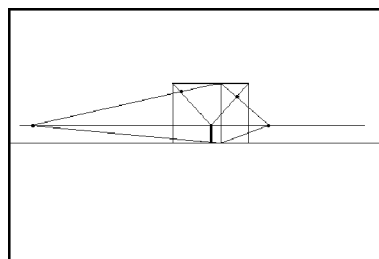
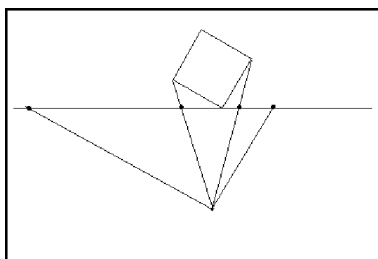
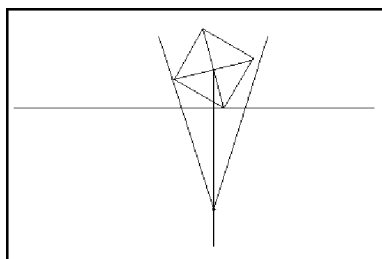
Using the computer to model and simulate the 'sun's trajectory' allowed the students to proceed to a more complete evaluation of the sun's effects on the environment, considering speed and visualisation offered by the computer in contrast to the traditional method usually adopted. In this way, the use of computers was quite effective with regard to the understanding and consolidation of the theoretical principles proposed by this module. However, it is not possible to say the same regarding the results of using computers independently of the specificity of this course. Unfortunately the time available was insufficient to allow a more stimulating relationship between students and machines and the computer was used purely as a representative tool.

The course 'Perspective'

In this course the computer was introduced in two different ways. Firstly it was used as a

teaching instrument, using a multimedia presentation to help the visualisation of the three-dimensional perspective. Comparing both two-dimensional and three-dimensional traditional methods of construction, the three-dimensional approach was clearly more readily understandable. Most of the students, who were taught the method of perspective using two-dimensional visualisation, were not able to fully understand the method at the first time. They also needed to practise the method step by step to be used to it, and only then were they able to create their own perspectives. Using computers to visualise the construction of perspective in three dimensions the students seemed to acquire a clearer understanding of the method first time, being able to build their own perspective in an easier way. (Figures 14 to 22)

In this presentation the lecturer was in charge of manipulating the equipment in order to



Figures 14/15 locating the observer

Figures 16/17 Flight points and sight lines

Figures 18/19 Perspective lines

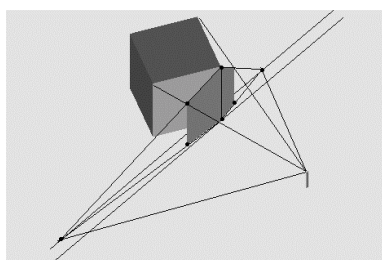
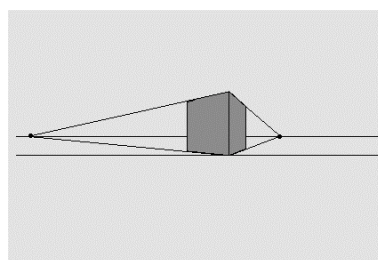
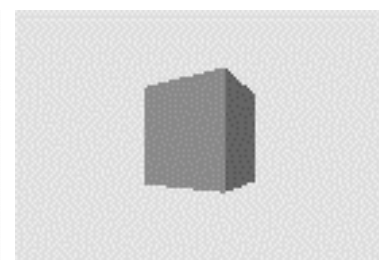


Figure 20 Perspective drawing process



Figures 21/22 Perspective according to the observer point of view



communicate the content of the multimedia - the students showed more passive and receptive behaviour in response to the content. Thus, this method of learning still followed the traditional process even after taking into account the improvement in understanding brought by introducing a better way of visualising.

This experience indicated the possibility of disposability of content through an interactive multimedia package, which could be used by the students at any time, promoting self-study independent of the lecturer's presence. In this way, it was hoped that the students would gain an active attitude to the content, which would probably contribute to changing the way they usually learn.

The second experience of using the computer in perspective was the introduction of a specific module to teach computer modelling. The main subject was still perspective presentation and the computer was introduced only as a tool to represent the architectural design in its three-dimensionality: the computer was not taken as a creative instrument during the design process. Thus, as experienced when teaching Environmental Comfort, the results were quite satisfactory with regard to the specific purposes of the course, but there was not yet any further investigation of a broader use of computers in architecture.

The course 'Computer Graphics'

From the experiences outlined above it was possible to realise the need for interactive tutorials covering the main contents of the

courses and also covering the main aspects of each software package used, as well as the need for a broader inclusion of the computer into the design process. Thus a specific course was created - 'Computer Graphics' - as an option for those students who wanted to learn more about CAD and how to present their architectural designs using computers.

This course was almost entirely based on self-learning tutorials. The main tutorial package covered from simple initial modelling to final presentations (Roberts and Santos, 1995). Following this tutorial the students were able to use the computer to represent their ideas from the beginning of the design process. They were then able to choose a software package which better suited their needs and skills. Usually they began by using some simple modelling package, such as 'Modelshop', to build the landscape (Figure 23) and also to start the initial mass block studies. It was then possible to export this model to a more complex CAD package, such as 'MiniCAD'. In 'MiniCAD' it was possible to generate triangulated landscapes (Figure 24) using the Macro Minipascal and also to transform the initial mass model into measured drawings.

A third software package, in this case 'Microstation', was also included in the interactive package due to its powerful rendering, lighting (Figures 25 and 26) and sophisticated modelling capabilities.

This last experience has proved to be quite effective as a teaching method exploring the self-learning potential. But, despite

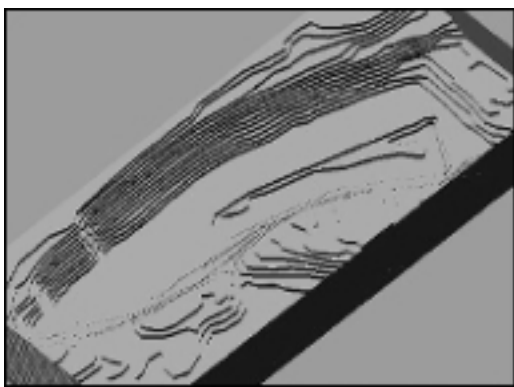


Figure 23 Modelshop landscape

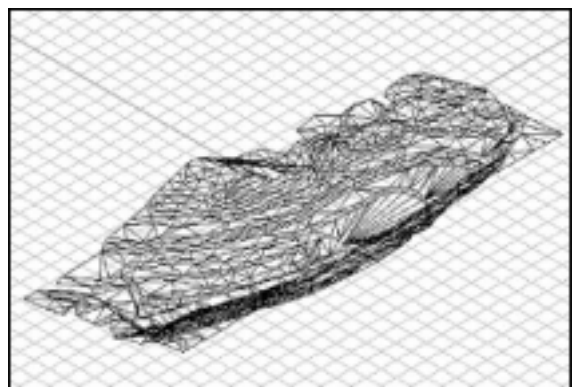
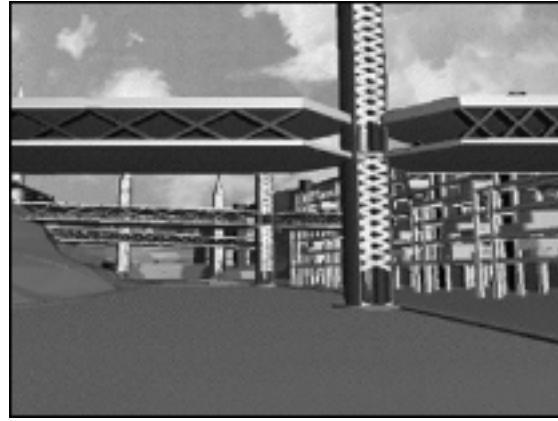
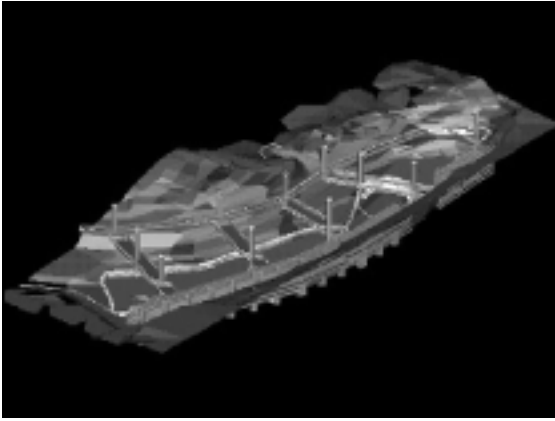


Figure 24 MiniCAD triangulated landscape



Figures 25/26 Design imported from Modelshop and MiniCAD and rendered in Microstation

encouraging the students to investigate different software packages and to use them during the whole design process, it only brought real improvements in representation and not in architecture. Actually, if there was any change in the traditional process, it was more related to quantity (the many CAD representations to look at) than to quality. Evaluating the results of this course it is possible to acknowledge the limitations of CAD (Figure 27) whose roots are based on the perspective paradigm originated in the Renaissance (Cabral Filho and Santos, 1997).

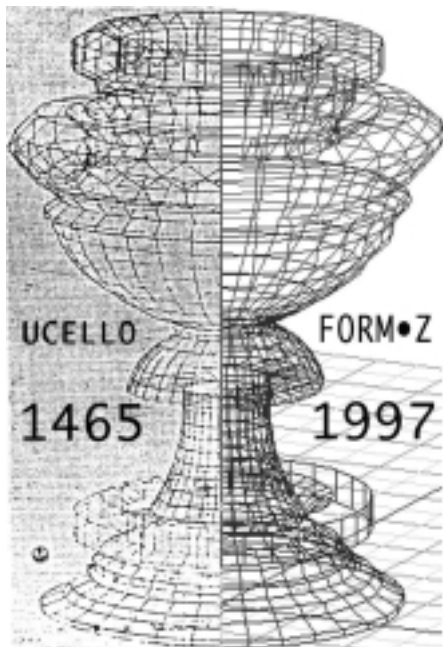


Figure 27 1465s perspective and 1997s modelling

The experience of the course 'IT applied to Architecture'

The 'IT Applied to Architecture' course is taught to the first semester students and intends to familiarise them, in a broad sense, with information technology. The main aim of the course is to develop the students' skills in a critical way: this is done through the so-called 'meta-learning' system, where the students not only learn how to operate architectural design software (CAD packages), but are stimulated 'to learn how to learn' to use the computer. In fact, rather than use a computer, students are encouraged to 'think with the computer'. It is given special emphasis in the analysis of the relevance of the machine for the current architectural culture. Thus, the computer is viewed as a special tool to support the whole learning process of the architecture course and not just as a drawing machine to support studio courses.

The achievement of this target depends on one advantage, which is the fact that the course is taught to first semester students who have not yet acquired 'vices' such as rigid representation habits. In other words, they do not have pre-conceived ideas about the function of a computer in the architectural design process, and are open to a broader and original use of computer technology. Usually the students develop their experience further, in particular and expressive ways, throughout their school years.

Course Structure

The course lasts 60 hours throughout one academic semester (16 weeks). It is comprised of four modules that allow the development of parts of a central theme, which structures the entire course. The underlying theme always refers to the issue of the intertwining of computers and architecture. Students are asked to investigate a provocative topic: "Architectural computation - renaissance or the end of architecture?" Each module incites the students to develop a new skill, in a cumulative sequence of increasing complexity:

- The first module approaches the written expression, when students develop a short essay about "The house in a computerised and networked world - electronic cottage or a machine to live in?" They are asked to use a word processor as a means for expressing themselves in unusual ways. This module also functions as a way of getting all the students roughly to the same level of proficiency concerning the basics of operating systems and networking, enabling them to use the computer laboratory.
- The second module approaches the two-dimensional expression through the elaboration of an image/collage about the topic: "Digital revolution and the city - new urbanity or new primitivism?" An additional requirement at this stage is the preparation of a short essay about image manipulation and its consequences for the contemporary culture.
- The third module approaches the theme "Architecture and its electronic image -

photo-realism or poetic evocation?" and it comprises the use of a CAD package for three-dimensional modelling. Besides the essay about the theme, the assignment for this module is the modelling of a specific building and the simulation of its insertion into some landscape (Figures 28 and 29). In order to face the usual problems with printers and colour management, students are asked to hand in a printed version of the work, usually a small poster composed with views and diagrams of the building.

- The final module approaches the question of multimedia representation of architecture and its insertion into cyberspace. The students are required to produce a piece of interactive multimedia presenting the previously modelled building, together with a final essay summarising the discussion held in the course.

It is worth noting that for assessment purposes, the same weight is given to the use of technology (the learning of software) and to the reflection about the use of technology (the essays), the final mark being the sum of both marks. In this way the students are compelled to acquire a critical position with regard to the use of IT applied to architecture. They become able to choose the software package which best suits their needs in the development of a personalised design process.

A good example of this course structure is the final multimedia presentation in which the students respond to the expectations of the course, using computers to think about



Figure 28 Insertion of the model in a painting



Figure 29 Insertion of the model in a real landscape

architecture. The multimedia is produced not only to show the three-dimensional model, but also to demonstrate the architectural qualities of the scheme.

The chosen case study was an Oscar Niemeyer design for a house which was never built. It was planned as a country house for two of the most important artists of the Brazilian modern movement. This movement changed Brazil's cultural scene at the beginning of this century. Oswald de Andrade, a writer, and his wife Tarsila do Amaral, a painter, started a new cultural movement called 'Antropofagia' that proposed a sort of cultural cannibalism as a reaction to European colonialism.

Niemeyer's scheme for their house is one of his most brilliant designs. Functional and symbolic questions are articulated in a very simple and direct way. The whole functionality of the house is sorted out with just one internal wall. Nonetheless, all that has been published about it are three small sketches and a photo of a very rough cardboard model. Such conditions are more than adequate for the purposes of the course, since it demands from the students a lot of imagination and creativity to grasp the totality of the project. In fact, it is transformed into an occasion to discuss the principles of modern architecture, (such as spatial continuity and the free plan), coupled with historical research about the importance of Oswald and Tarsila.

Furthermore, the geometry of the house presents the exact challenge for the students as far as the CAD package is concerned: a combined roof (curved and straight), a mural by Tarsila, different materials natural and artificial, etc. Thus, the multimedia ends up being the milieu for articulating a new way of thinking and expressing these thoughts in a pluralistic manner, which would be difficult to manage without a computer.

It should be noticed that the storyboards are more complex than the real process. This complexity is due to the difference between the way man thinks and the two-dimensional possibilities of representation. Two-dimensional representation is limited by the medium in which it is presented and also by

being a kind of description of a previous phenomenon (Heidegger, 1990). Thoughts are unlimited and work as a web with many layers of connections as a hypertext structure (Nelson). In the case illustrated here the students used a multimedia package to directly 'think with' and not just to represent their previous ideas or formalise their presentation. The hypertext structure of thinking is replaced by the hypertext potential structure of the package, which makes the final presentation possible. In this way it is possible to reduce the gap between representation and thoughts (Santos, 1998) due to two main things. The first is the use of a package (in this case Macromedia Director) which allows many layers of connections between all the elements presented. The second is to use the computer to think with, as a creative tool, and not just as a representative one. Thus, the presentation process - allowed by the software package - is similar to the way the students think; the computer is being included as a complementary tool aiding not just the architectural design and its representation, but also taking part in the creative process of thinking architecture.

Conclusion

Based on Lagear's experience it does not seem appropriate to focus any course on teaching software packages. Besides the fact that software packages become obsolete in a short period of time, there is also the fact that the students are not stimulated to investigate the whole potential of the computer, which is able to run many different software packages.

Using computers to think with and not just to represent with.

Bruegmann (1989) pointed out that CAD software did not bring any substantial change in the methods of production of architecture. This is due to the unquestioned use of the perspective paradigm and its principles established 500 years ago and used today as the logic structure of CAD packages (Cabral Filho, 1993). The CAD packages available just fix the traditional process of design instead of opening new ways towards a broader investigation of representation and a real

change in the design process.

This paper has discussed two main ways of introducing the computer in architecture establishing a subtle but strong difference between them. The first one is the use of the computer, mainly CAD, as a tool for representation; the second is a more dynamic use of the computer as an instrument of creativity.

As shown by the experience of 'IT Applied to Architecture' it is possible to teach CAD, as well as other software packages, as experimental instruments supporting the students' design skills and also as tools to think with.

It is the belief of Lagear's staff that through the 'meta-learning' proposed by 'IT Applied to Architecture' the students can become able and open to perceive architecture and computers in their many dimensions. Many students who did this course used to return to Lagear to develop their works for other courses, such as 'History of Art and Architecture' and 'Architectural Design'. The qualitative change imposed by thinking with computers is clearly visible in the students' presentations. It is possible to consider IT as a herald of paradigmatic change in the architectural design process, from perspective to information, and that is why Lagear encourages the students to think with technology and not just to apply it.

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