Training Programs for Art and Design Learning in the Virtual Studio

Francisco Olmos
The Bartlett School of Graduate Studies. University College London. England
f_olmos_2000@yahoo.com

Computers are very common drawing tools at university design studios but their potential as training tools in arts and design has not been explored in depth. In arts and design the learning process is based on ‘knowing in action’ (Schön 1983). Therefore, training is the keystone of the learning process in arts and design. This action takes the form of a reflective practice based on the manipulation of a media where each media has its own possibilities, its own limits in communicating design ideas or artistic concepts. With the introduction of digital media in the design studio, it is expected that reflective practices in design learning will experience a qualitative change. However, currently there is little understanding of how to use the digital and virtual media in a design studio as a learning tool (Szalapaj 2001), nor of the use of design training programs. In this paper the use of training programs in an experimental design course at a university level, is discussed. This experience was carried out as a PhD research experiment at the Faculty of Architecture and Arts of the Universidad de Los Andes in Merida, Venezuela. The training programs discussed here were designed for an eight week introductory design course in a virtual design studio. The programs were written in VRML and conceived as a virtual design training environment. Each program was designed for a specific design exercise, based on a learning strategy and an interactivity model proposed for object manipulation in design training. A comparative analysis of the data gathered from the course was made of training exercises done with a Cad program and with the training programs and crossing information with other sources. The experiment shows that the training programs, their learning strategy and the interactivity model proposed were successful in guiding the scope of the design exercises during the training process.

Keywords: E-learning; virtual studio; design training; virtual environment.
Introduction

Electronic media and virtual environments introduced in architecture practice have found the way to become very successful and productive tools. Actually there is no doubt about the commercial value of electronic media as a representational tool in the professional field but at the design studio it is not clear how to use this new technology as a learning tool. CAD, CAM, CAE programs, Virtual Environments and parametric design have been used in design fields successfully for years. Avant garde design techniques, such as Shape Grammar, Genetic Algorithm, Evolutionary Design, have been used successfully too. However, the use of electronic media in the design studio has been limited mostly to the use of CAD and CAM programs as drawing and modeling tools.

So called computer aid design programs in fact are aid drawing programs and they were not conceived for the needs of the learning process in the design studio. There is a paradox of learning reflective practice in design that should be considered to develop any training strategy for design learning based on electronic media. This paradox consists of the fact that “the student does not yet know what he needs to know, yet knows that he needs to look for it. His instructor cannot tell him what he needs to know, even if he has words for it, because the student would not understand him” (Schön 1985). This paradox has its origin in the nature of design study, in which it is more feasible to learn to design than to teach design (Lawson 2000). Design is learned by doing, through reflection in action, based on ‘ideas to think with’. This process eventually will lead the students to reach the non discursive level of design knowledge of ‘knowing how’. On the other hand ‘design as a process of cerebration is not simply a procedure that draws on knowledge, but one where the process is actually based in knowledge and how the designer handles it” Hillier (1996). This is the context in which we have aimed the research, to propose a new way to enhance the process of reflection-in-action in the design studio, based on digital media and virtual reality technology.

In this paper a proposal for the introduction of electronic media as a learning tool in the first year architectural design studio, is discussed. It is being carried out by Francisco Olmos in his PhD research, supervised by Alan Penn at the University College London. The proposal consists of the creation of ‘design training programs’ for the specific peculiarities of the ‘learning by doing’ style of design studios.

What are design training programs?

Design training programs are not CAD or drawing programs, they are virtual training tools used to perform design exercises in real time. They consist of a virtual training environment for specific design exercises based on a set of objects that can be manipulated to some extent. From the point of view of training the ‘mental muscle’ these programs are analogous to strength training machines in a gymnasium. They permit students to practice and develop specific design skills in a controlled situation which can be applied to any design activity. This learning strategy based on controlled activities and objects, far from limiting creativity, helps students develop their own way to express it. Proof of this will be discussed in this paper later.

Let’s have a look at the main features of the training programs. Firstly, for designing a training program should have a simple and intuitive self-explanatory interface, in order to free the student from the cognitive load of learning the meaning of icons or how to
use a virtual tool. The simplicity of the interface helps to control the development of the exercise, limiting the variables playing in each one. Figure 1, shows the interface of one training program used in an experimental virtual design studio. The work space in the interface consists of a white square and the objects, points and lines in this case, made available for carrying out the design exercises. Students can create as many points and lines as they need. They can be dragged and rotated freely across the work plane but they cannot be resized and their appearance cannot be edited. The interface allows visualizing the design training exercise from different points of view.

Secondly, the training program is designed for specific design learning experiences. These are not multipurpose programs. The use of controlled objects and functions in basic design training exercises are for the purpose of keeping the range of design solutions focused on the design concepts being studied. The structure of the program created a working model that keeps the result inside similar parameters, guiding the student’s learning process.

Thirdly, the interaction model proposed for the design training programs is a key point. CAD programs usually create or modify the parameters of objects through the use of tools and menus. The interaction model is based on the user-tool-object relationship. Virtual tools generally have a specific specialized function. A menu window permits introducing new data to create or modify object parameters. Training programs are based on different interaction models. The one proposed here is based on a direct user-object relationship. In this model manipulation of the object is based on the idea of objects with behaviours that can be triggered by the user touching the object with the pointer. This model rids itself of tools. The pointer here is not a tool, it is a virtual extension of the user’s hand which can be used to perform any action. The duality between the tool and object doesn’t exist any more. Here the functions that can be performed by the tool are embedded in the objects. The virtual object has specific and limited behaviours that can be triggered from the object itself with the cursor or with a finger (with sensible screens or in immersive VEs) in real time. These behaviours can go from simple actions, such as to rotate or drag an object, to scale it or even more, to have “intelligent behaviours” according to the training activities.

This object manipulation model has some cognitive advantages over those of CAD programs. For example: to rotate a virtual object using a Cad program, in most cases it is necessary to perform four actions: 1-Select the object. 2-Select the tool. 3-Define a rotation point. 4-Define a rotation angle and direction (by graphic means or with a menu). If the final result is not satisfactory steps 3 and 4 should be repeated. With a training program the user only has to click the object and rotate it in real time to the desired position. This model reduces the learning curve to an extreme and allows a real time visual feedback with an efficient use of time.

Training programs in action

In this point a group of design training programs and their exercises, designed for an experimental research course at the Architecture and Design Faculty of the Universidad de Los Andes in Mérida, Venezuela, is described. The training program and exercises performed with them, their main features and learning objectives and students’ experience with them will be discussed herein. These training exercises were conceived incorporating Kandinsky’s (1922) theory of the picture plane with respect to the schema of weights.
into the design of the training program. In modern times the origin of these exercises is at the Bauhaus School in Germany. The innovation introduced in these exercises comes from the media in which they are performed and the constraints introduced through the training program in the reflective practices. These exercises are linked to theoretical lessons that describe the main concepts or ideas associated with the exercise, both those of the configurational concepts being studied and the symbolic concepts associated with the forms themselves.

The training program ‘points’
These exercises made with this program consist of doing compositions based on points by applying the configurational concepts of nearness or grouping, continuity and rhythm. The points should not be superimposed and the students have to analyze their compositions basing themselves on Kandinsky’s picture plane theory. They should use the training program’s tools provided for the program while doing the exercise and afterwards. These tools are the changing background button and the view point button, figure 2. The view point button allows changing the background of the picture plane into four different schemas, figure 3 (a,b,c,d), related with Kandinsky’s picture plane theory.

The view point button makes it possible to rotate the compositions not only from the front view but from the back, too. Students have the opportunity to observe 8 different variations of the same composition related to the picture plane as we can see in figure 3. The aim of this is to develop a student’s perception of the visual energies of the picture plane. Once students have observed the different variations they hand in the original and two or three more versions that they like.

The training program ‘lines’
This exercise is similar to the previous one but based on lines. Figure 4 shows the interface for the lines training program. The compositions are based on lines that can be superimposed. In these exercises students explore the visual energies of lines based on Kandinsky’s theories. The configurational concepts of direction, continuity and rhythm should be applied also. The compositions were analysed by the students from different points of view in the same way.
manner as the previous exercises. They also hand in the original and two or three variations. Figure 5 shows some of the students’ submissions.

**The training program ‘points and lines’**
The points and lines exercises allow students to explore the visual energies of points and lines together and some concepts related to them. A point is static, it defines a position, a place in space. A line is movement and defines directions in space. The programs interface, figure 1, joins together the design elements of the previous exercises with the same functions. Figure 6 shows some examples of students’ hand ins.

To access the students’ learning experience, information was gathered from students’ portfolios, questionnaires and interviews with participating students. The questionnaire revealed that 75% of the students found the use of the training programs normal and 25% considered them difficult. Identification of the program interface functions was considered suitable by 62.5% of the students and 37.5% found this identification poor. In general there was a positive evaluation of the use of the training programs, which were also favoured in their personal opinions: “Training programs were much easier to use.” “Training programs are easy to use but Cad programs have more advanced tools.” On the other hand, direct observation of students’ performance shows that they learned to use the programs in a few minutes.

Training programs, interface design and the object manipulation model seem to be accepted by the students because of their high level of friendliness and simplicity. There is no need for a lengthy sequence of steps to perform an action as is required in a Cad program. The use of a menu to assign degrees is more related with the logical functions of the left brain. It is an abstract action with no visual feedback until the actions are concluded. Graphic means, such as rotational abstract references or an axis, are also an intangible approach to form configurations, because while tracing lines to set new positions do not represent the object itself, they are not as intuitive as the training programs. With the training programs students only have to click the object in a specific place to activate the rotational behaviour and then rotate it in real time to the desired position. Intuitively the student can decide where to place the object. At this point the right brain has the opportunity to develop a sensitivity to form configurations. This is a great advantage for educational purposes in design because perception of the object’s movement in real time allows students to perceive and evaluate intuitively the consequences of configurational actions.

The result demonstrated that the interactivity model based on a direct user-object relationship proposed in this research is more intuitive than the traditional interactivity model based on a user-tool-object relationship and is much easier to perform. In
these experimental programs the object’s behaviour is very simple, drag and rotate. However, depending on the exercise the object can have as many behaviours as is needed, and moreover, it can have ‘intelligent behaviours’.

Guidance exercises within the training programs

A crucial feature of the training programs is the control capability of the reflective practice during the training process. Access was achieved with a comparison of the same training exercises made with the training programs and with a CAD program.

Point training program exercises
In the students’ portfolios is one of the best points compositions made by students with the point training program, figure 7 (a), and one of the worst, figure 7 (b). The first case shows a composition which evidences the application of the design concepts being studied. Here the student also explores the picture plane properties creating a dynamic composition.

The second drawing, figure 7 (b), is one of the worst made with the points training programs. There is a lack of visual rhythm and a rigid use of the picture plane properties which results in a static composition, although the students applied concepts of continuity and grouping and took into account the structure of the picture plane. The following pictures show the same drawing exercises done with a Cad program. These compositions were made after using the points training program. As in the previous cases this is one of the best compositions made and the other is of the worst. Figure 7 (c) shows an interesting composition made with a Cad program in which the student, free from the restrictions of the training programs, explores the picture plane structure applying concepts of continuity, grouping and others, such as contrast and gradation. On the other hand figure 7 (d) shows a chaotic composition in which the student did not achieve the exercise’s objective.

Lines training program exercises
In this exercise students were supposed to apply in a composition the design concepts studied in the theoretical contents of the training session: direction, visual movement and rhythm; in this case associated with lines and Kandinsky’s theory of the picture plane. Following is the structure of the same analysis as in previous exercises of one of the best lines compositions made by the students with the training programs, and one of the worst, also with the CAD programs.

The first drawing, figure 8 (a), shows a composition that, through the rhythmic disposition of vertical lines, creates a visual movement which is contrasted by other groups of lines. On the other hand, figure 8 (b), shows a composition based on three main groups of lines, based on the same visual rhythm but not very well related with other lines, which disarticulated the visual rhythm. The following compositions were made with a CAD program after using the lines training program. Figure 8 (c) shows a composition that using simple elements and through the understanding of the visual energies of the picture plane’s directions created a good composition. On the other hand, in the second drawing made with a CAD program, figure 8 (d), there is a disaggregated composition that did not achieve the exercise objective.

Figure 7
Comparison of point training exercises
Points and lines training exercises
This exercise consists of applying the design concept of continuity, rhythm, direction, nearness and Kandinsky’s theory of the picture plane in a composition based on points and lines. Figure 9 (a) shows one of the best compositions made by the students in these exercises and figure 9 (b) one of the worst. The first case shows a dynamic composition that covers the expectations of the exercise. The second case demonstrates a poor composition with confronting lines and a succession of points. The rhythm is repetitive and static and the composition lacks an illusion of space. Even though the composition doesn’t meet exercise expectations the student applied a few design concepts, such as rhythm, nearness and continuity and explored the structure of the picture plane. As in the previous cases one is of the best compositions made with a CAD program and the other is of the worst. Figure 9 (c) shows a very good application of the design concepts being studied while 9 (d) shows a very bad example.

The findings
The comparison of the same training exercises made with a Cad program and with a training program, plus student opinions and their training records reveal some noticeable findings that will be mentioned here. Firstly, there is a difference in the use of colour. The training program work is based on black and white visual contrast, due to the powerful influence of colour on the perception of form. The use of colours introduces additional levels of complexity on formal configurations and for a short introductory design course it is convenient to avoid it, in order to focus on the most basic configuration concepts. Using Cad programs all the students introduced colours by themselves, in some cases very well, in others not. Secondly, and the most remarkable finding here, was that the best compositions made with the Cad program were superior to the best compositions made with the training program. However, the poor compositions made with the Cad program were inferior to the ones made with the training program, when it could have been expected that they would have been better, as they free students from the restrictions of training programs. This contradiction comes from the controlled parameters of the training programs that help students to keep focused on the training exercise. When students have not internalized the design concepts yet, the use of a Cad program makes them lose the objective of the exercise, which does not happen with the training programs. The number of available virtual tools and drawing possibilities seems to distract students from the objective of the exercise when they lack training in the use of design concepts. On the other hand, students who have internalized the design concepts after accomplishing the training activities found their own way in using the design concepts when working with a Cad program or any other media.
The answers on the questionnaire help to understand these findings also. A student said that “Using a Cad program is more stimulating and creative, while training programs are the opposite”. “The Cad program has much more tools to do the same thing.” Students found the training programs restrictive in a negative sense, but evidence shows that these restrictions, far from cutting creativity short, help it on its way. Just as in any activity based on learning by doing, training actions are not exactly the same that would be put it into practice when performing the abilities learned. In arts and design internalization of design concepts, such as ‘ideas to think with,’ through practices, it is fundamental to act creatively when designing. On the other hand, the few actions that can be performed to manipulate the objects reduce the learning curve which is highly desirable in a virtual learning environment.

The training strategy embedded in the structure of the training programs limits the range of objects and possible configurations. The idea of these restrictions is to take the training activities into the abstract level in which design ideas are the “raw material out of which all configurational possibility in space and form in the built world are constructed” (Hillier 1996). These restrictions focus students on manipulating the configurational concepts more than the forms themselves. On the other hand, the reflective practice depends on the feedback received while designing. This feedback also should be controlled by the designer during the reflective practices in order to keep the focus on the design goal. The program helps students control feedback and possible solutions during the training process in a non intrusive way.

**Conclusion**

The use of training programs to introduce computer technologies in the reflective practice of design studios was proven to be an effective design training tool within limits. There was a limitation due to the fact that the course only covers basic design concepts from a bi-dimensional point of view. However, the main features proposed for the creations of training programs proved to have important cognitive advantages over the used of CAD programs for design training purposes. Moreover, evidence suggests that the use of CAD programs could be counterproductive for novel students that have not as yet internalized the reflective practice of the design studio. The training strategy embedded in the structure of the training programs, based on the interactivity model of user object-with-behaviours, proves to be an effective learning tool that directs design training in a non intrusive way. On the other hand the self explanatory style interface and the use of a limited number of virtual objects prove to be effective in reducing the program learning curve. This reduces the extra cognitive load of using CAD programs with dozens of tools for the same result, allowing students the opportunity to focus on the design concepts instead of how to use the program. The training program concept proposed here opens a bridge for the introduction of computer technologies as an effective learning tool able to lead the process of reflection in action in arts and design studios in a non intrusive way.

**References**