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An industrial designer's approach to a virtual learning environment

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Abstract

Widened access and lifelong learning trends in modern education require that web-based Learning Environments be designed as student-centred education and support mechanisms.

Many Virtual Learning Environments are encumbered by a steep learning curve detrimental to their full employment. Students with lower levels of computer literacy struggle particularly.

This paper reports:

- 1 the way in which the traditional Industrial design techniques are used to create virtual Graphical User Interfaces (GUIs) which can be used "instinctively" by students with lower levels of computer literacy;*
- 2 a case study of the design of a multi-media learning environment examines the ways in which mutually reinforcing learning methods can be utilised to place students at the centre of universities learning policies, allow efficient information storage and retrieval; and on*
- 3 the potential for future development of such systems.*

Keywords: computer-supported design, designing & learning, ergonomics & design, industrial design, multi-media, product semantics

Introduction

Recent trends in post-Dearing higher education towards lifelong, open and distance learning require that web-based Learning Environments be designed as student-centred education and support mechanisms. It follows that the interface for such a system must be in tune with the needs of a wide range of users with a range of abilities.

Many Virtual Learning Environments (VLEs) are encumbered by a steep learning curve detrimental to their full employment. Students with lower levels of computer literacy struggle particularly.

Since December last year, we in Cardiff have been involved in the design of a new Virtual Learning & Communication Environment (VL&CE) for use by both staff and students.

For a number of years, we have had access to

excellent on-line learning materials, databases, e-mail, staff web space etc. With the possible exception of e-mail, these are so far under-utilised.

There are a number of excellent VLEs available already (such as the *Nathan Boddington Building* (University of Leeds 1997)).

The *Nathan Boddington* model allows students to work in seminar groups, sit tests on the World Wide Web, belong to seminar groups, retrieve lecture notes, etc. It is a very sophisticated model and is utilised by academics and students across the University.

The Cardiff model aims to emulate these functions, but we are also attempting to

- create a social environment that connects staff and students with other parts of the university;
- harmonise the VL&CE with the real world

environment;

- tackle the social aspects of learning;
- make information retrievable by the individuals with moderate to poor IT skills.

This paper reports on:

- 1 the way in which the traditional Industrial design techniques are used to create virtual Graphical User Interfaces (GUIs) which can be used “instinctively” by students with lower levels of computer literacy;
- 2 a case study of the design of a multi-media learning environment examines the ways in which mutually reinforcing learning methods can be utilised to place students at the centre of universities learning policies allow efficient information storage and retrieval; and on
- 3 the potential for future development of such systems.

The relevance of traditional industrial design techniques

Three dimensional computer models are very “byte hungry”. Although research was underway in the early 1970s (Coward, 1973) it was not until the late 1980s that 3D CAD became a practicality.

The World Wide Web is limited too, in this case not by the computers linked to it, but by its connections. Although there have been a number of developments recently, web-based material is currently more or less limited to two dimensions because of the data transfer rate of a standard phone line (about 2.8 KPS).

Given this and the fact that industrial design is a 3D discipline, how could an industrial designer’s core skills be useful?

As any Industrial Designer will say, the most efficient way of designing an effective, useable, Graphic User Interface (GUI) is to make its use *instinctive* to the user. One of the basic methods of instinctive languages commonly used in GUI design is the *spatial analogy*.

Spatial analogies are an excellent example of the value of three-dimensional thinking for

good interface design.

Example 1: A two-dimensional space analogy

As the reader will know, modern computer keyboards have a collection of buttons with arrows on them that allow the user to move a cursor or an object. (See Figure 1)

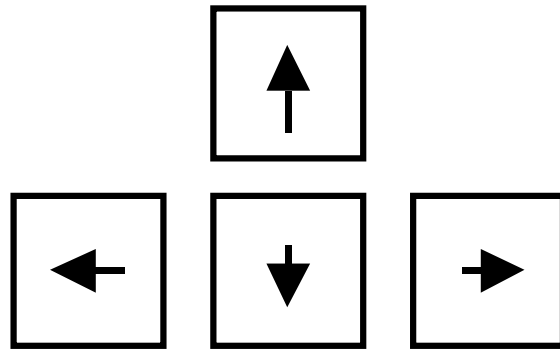


Figure 1 Computer keyboard direction keys

The keyboard sits horizontally on the desk so that the arrow on the isolated key is pointing away from the user. The user is looking at a vertical screen and knows that although the arrow is pointing away from them, if it is pressed the selected item will move *up* the screen. The user knows this will happen because this type of spatial analogy and its transposition from horizontal to vertical is a convention reinforced over time to become *instinctive*.

So, a forward pointing arrow also means *up*.

Example 2: A three-dimensional spatial analogy

Picture the same keys displayed in Figure 1 being used on the same computer keyboard as the controls of flight simulator software.

We know from the two-dimensional spatial analogy that the *forward* arrow can either mean *forward* (in its horizontal mode) or *up* (in its vertical mode).

If the user wished to make the aircraft go *down*, which key would they press?

Surprisingly, the answer is the *forward* arrow. To explain why, we must move from two to three dimensions.

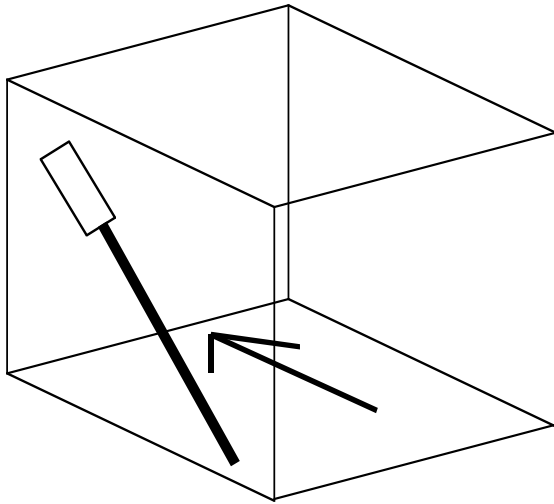


Figure 2 Three-dimensional representation of space

The bottom face of the cube in Figure 2 represents the plane on which the keyboard resides and the back face represents the plane on which the screen resides. Let us look at the scene from the left-hand face of the cube.

This face has a diagram of an aircraft control column on it. When the forward arrow is pushed, the user's mental model is of a control column being pushed in the way shown in the illustration. It moves forward *and down*.

So why was the control column designed the way it was? This is another example of a spatial analogy.

The reason control columns work the way they do is because they are an excellent example of a sophisticated three-dimensional spatial analogy and are therefore used instinctively. (See Figure 3)

If one were to place a model of the aircraft on the pivot of the control column, the model would faithfully reproduce the spatial movement of the aircraft. The mind employs this mental model in order to control the machine. It is an exemplar of good three-dimensional design ergonomic practice.

Another basic technique in the industrial designer's armoury is product semantics. There is a long-standing "language of products" that firmly indicates to a user when a control mechanism is a button, when it is a

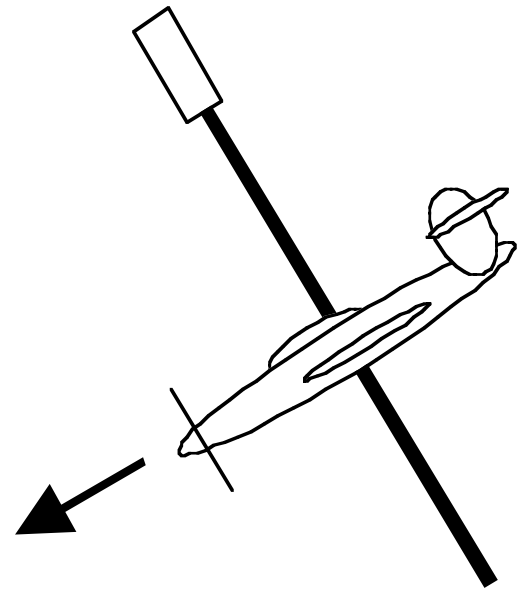


Figure 3 Joystick spatial analogy

dial, when it is a lever, etc. This can be combined with a product *grammar* (Norman, 1998) that allows combinations of controls and signs to have further meaning.

These two techniques alone are very powerful and, properly utilised, will create products with which the user will instantly feel comfortable.

Case study: The Design of a Learning Environment by an Industrial Designer

The first problem the designer was faced with at the start of this project was how to make users *want* to interact with the environment. Five major principles were decided upon.

- 1 The learning curve should be short and flat (instinctive)
- 2 Information should be easily located and retrieved
- 3 The system should be mutually reinforcing of real world information
- 4 The system should be entertaining to use
- 5 The system should facilitate better communication across the University.

Shortening the Learning Curve

A spatial analogy familiar to both students and staff needed to be created. That way, creating a conceptual model of the virtual world in the mind of the user would be easier because it used information they already held (making use of the environment *instinctive*).

It was determined that the University campus should be used as the spatial model for the project. Sites would equate to rooms, each room connected to the others in the same manner as they were in the real world and each given their real function. In this way users would be able to get the information or person they needed by simply asking themselves where they would look in the real-world model.

Although each web page was planned as a two dimensional representation from the beginning, the user used a three dimensional spatial analogy to "navigate" the environment.

Another fundamental principle adopted was to equate the Learning Environment to a product. The chance of a student reaching university without having used a range of consumer products is slight. Consumer product semantics were used to help the user feel more at ease in the virtual environment. Areas where text appears have been displayed as screens; buttons have been set into surfaces; and instrumentation has been designed to reflect the appearance of real world products.

Other product icons are more symbolic. One example is the doors. Each "room" has a number of doors that allow the user to exit. These have been included because of their real world connotation and appear as symbols within the symbolic (virtual) product.

A campus map forms the opening page (see Figure 4). A number of convenient conventions have been used. For instance, the real scale of the campus has been entirely abandoned. Building plans have been simplified and re-sized and unused spaces reduced dramatically (a concept devised by Harry Beck, and used in his 1933 London Underground map). Other conventions have been dropped too. The map does not align with the viewer's viewpoint, nor is there an association between "Up" & "North".

The user navigates by pointing the mouse over the areas where he or she expects to find rooms. When a room highlights, then he or she clicks the mouse to travel there. The user can now "travel" where he or she wants. If for instance they wanted to contact a member of staff, the most obvious place to do so would be that staff member's staff-room. (See Figure 5)

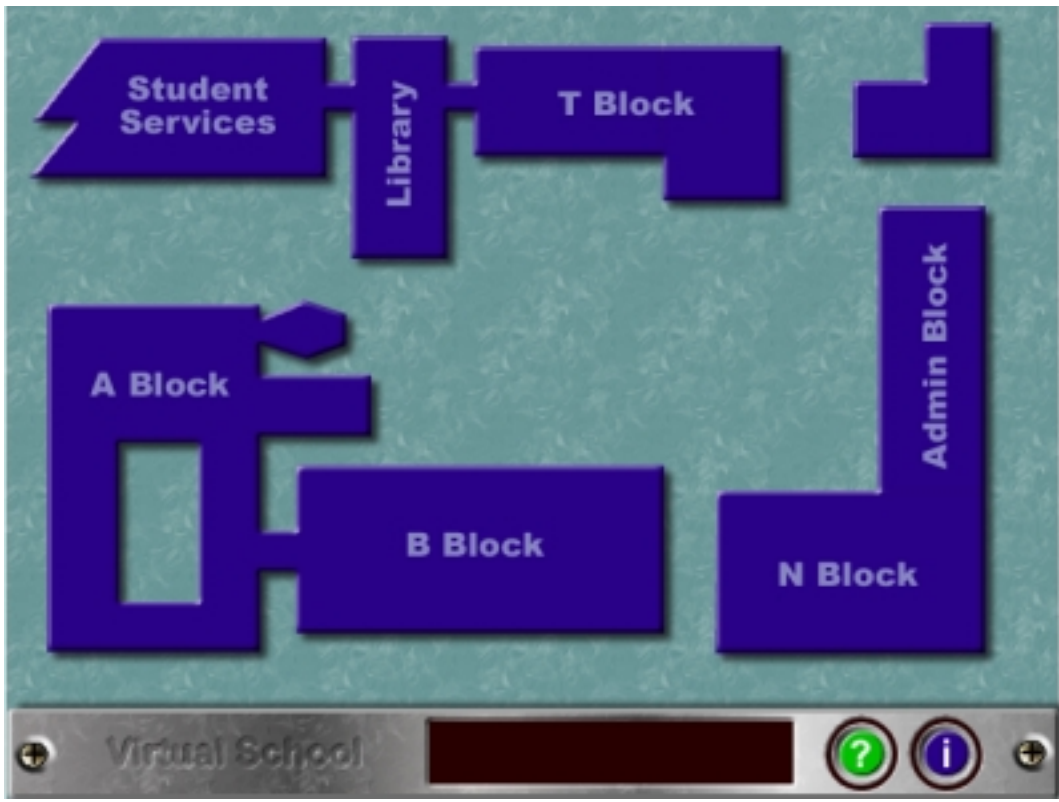


Figure 4 Map page



Figure 5 Virtual school staff room

Making the Environment enjoyable to use

A good example of the effort expended on creating an entertaining environment is the e-mail facility. If a user wishes to e-mail someone they move the mouse over that person's image on the screen. The person turns to the user and asks to be e-mailed. The user presses the mouse button and an e-mail window will appear. The extra effort required to create the necessary rollovers and sound bytes, not to mention the extra webspace occupied by such functions, has to be balanced with the undoubted pleasure students get from using a device with this level of feedback. What may at first appear frivolous is in fact a calculated attempt to ensure the user wants to use the product.

In other areas too, deliberate sacrifices have been made in order to maintain an entertainment aspect. A "navigator" has been provided that resides in the lower left-hand side of the screen. The most efficient manner of presenting location information is probably a simple text message. A dial, however, was chosen because of its connotations of quality and solidity and to add to the "quirkiness" of the environment.

Lights illuminate, buttons depress and screens light up with their messages, all adding to the illusion of a real, entertaining, three-dimensional product-based environment.

Making the Environment mutually enforcing

The system is mutually reinforcing by being "face and space-based". People can be contacted if **any two** of the following are known:

- Where they work
- Their name
- What they look like.

Students and staff can learn to associate names either through real-world contact or through the virtual environment.

Other mutual reinforcing principles include real world "hints" such as the mimicry of symbols used in the real world in the virtual environment. A good example of one of these is the "1" in the top right hand corner of the 1st year studio "room" (see Figure 6). The same symbol appears in the same position of the real 1st year noticeboard. The presence of this in conjunction with the drawing pins on the corners of the notices is designed to act as a



Figure 6 Virtual School 1st Year Studio

clue to the space's use.

Information should be easily located and retrieved

In order to make it easy for users to retrieve information, the system allows webmasters to filter information before it reaches the user. For example, in the real-world model, Design 1st year students share their studio with the 2nd year. Although they share the same physical space they are following an entirely different programme of lectures, visits, etc. In order to remove extraneous information each student is asked to logon before entering the Virtual Environment. This allows the system to give them only the information relevant to them. A first year entering the Main studio (see Figure 6) will see different information from that seen by a second year but will have all the same services available to them.

The same system allows for better access to useful web addresses, databases, search engines, on-line learning materials etc.

Facilitating better communication

The last of the fundamental goals was the facilitation of better communication between

students and academic staff, and providing a vehicle to link various components of the university.

One of the difficulties associated with creating part-time courses in Industrial Design has been that the studio environment is so ingrained in the design culture (notwithstanding trials already reported (Barlowe, 1999)). This was the reason that an e-mail database has been included to allow students to contact one another. It was felt that this would be one method by which part-time students might be able to stay in touch with the year group, keeping involved socially and in a position to ask for help and advice from colleagues.

Another area addressed was the services of the Campus nurse. The nurse was moved into a new building last year as part of a drive to provide students with improved facilities and service. It was noted that the number of students making use of the service actually declined when it was moved to a higher profile area. The reason turned out to be that students were embarrassed to be seen visiting the nurse in this more public environment.



Figure 7 Virtual school nurse's room

This was an area to be tackled (see Figure 7): the environment made getting in touch with the nurse easily and virtually anonymous. If the required advice could not be dispensed by e-mail then an appointment could be made, but the difficulty of the first approach was softened by the method in which it could be made. Information about the services available is also included in the "room" and this further aided the communication aspect.

Future Developments

The project is presently in prototype form. Some of its present functions have been detailed above; a number of developments are planned.

Analysis of the prototype has demonstrated that the face-based geographical model works well and a number of the planned developments are based on this. There are already projects underway at Universities, including Northumbria and Brunel (Nam and Wright, 2000), looking into collaborative working using the Web. This work may have a direct bearing in this arena and it is one of the areas the team is keen to explore.

Some of the limitations of the Web have been detailed above, but software from Macromedia, Apple and JulyNet Co are providing methods with which to explore 3D objects from a number of 2D images. There are a number of uses we are currently investigating for this type of platform.

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