# A Multidisciplinary Approach to Masters Education in Digital Research

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The Digital Design Studio of the Glasgow School of Art was developed in response to rapid advances in leading-edge digital technologies. This higher education program encompasses three distinct constituents: education, research, and training.

In general terms, it is difficult for any education system to respond rapidly to developments in advanced technology. Inevitably, this is because of the time it takes to prepare and enshrine new knowledge in an educational context and, in some cases, because of the financial outlay involved. This is particularly the case in digital technologies concerned with prototyping and animation using the most advanced packages. In education at the university level, there were no courses specifically developed to cater for this requirement. In 1997, a wholly new studio was conceived to fill this gap at the Glasgow School of Art, one of the UK's most well known art and design institutions and home to the Art Nouveau architecture of Charles Rennie Mackintosh. The Digital Design Studio, as it is now called, had its genesis in the design faculty, but rapidly developed its own ethos and mode of operation in a site remote from the main campus.

The idea behind the studio was to create a leading-edge facility within the higher education sector in the UK, which would act as a flagship for 3D digital technologies. It was recognised, however, that the huge expense involved in creating such a facility would require a wholly different approach than normally employed. Thus, a strategy was developed at the outset to engage companies that were themselves at the leading edge of these technologies. SGI and Alias|Wavefront formed significant educational partnerships and a shared view of the overall aims of the studio. At the same time, industrial partners were sought, including The Ford Motor Company, the BBC, Unilever, Red Lemon, Picardy TV, and DERA (the UK Defence Evaluation Research Agency).

Because of the strategic role that the Digital Design Studio would have at a local, national, and international level, an ethos was developed which spread the studio's remit across three important and interlocked areas: education, research, and training.

## Education

At the heart of the studio's educational activity lies the two-year multidisciplinary masters programme that was validated in 1997. From the outset, it was considered essential that this course would bring together graduates from a variety of backgrounds and disciplines. This strategy appears to have paid off, and to date graduates with the following backgrounds have been recruited to the masters programme: psychology, marine engineering, astrophysics, fine art, product design, marketing, animation (conventional), graphic design, and clinical science.

The broad aim of this two-year programme is to bring participants to a high level of capability in advanced 3D software, together with a critical sense of how to deploy it, particularly with reference to the subject matter of their first degree. That is, if a student applies with a degree in engineering, we would expect to see the new skills developed focused on animation related to engineering subjects. The course was also designed as a platform for identifying and promoting PhD candidates, although it is worth noting that the studio has now recruited its first student already in possession of a doctorate. In recognition of the timeliness and importance of this course, a number of places are funded by external organisations, most notably the BBC and the British Defence Evaluation Research Agency.

The masters programme does not require prior computer experience as a prerequisite. As a rule, technology and all reference to it is subordinated to an "ideas-first" principle in which the technology used should be as transparent as possible. Year One of the programme is about learning new skills, and through imaginative staff-led projects, students acquire the basics of 3D modeling, shading, and animation. As expertise is accumulated over the course of Year One, students are asked to develop an individual programme of study to be undertaken in Year Two. This study, in effect a small-scale research programme, requires elements of the students'first degree expertise to be exploited through the newly acquired skills in 3D visualisation and animation. It is astonishing how rapidly people can learn and master what is often complex and convoluted software. The multidisciplinary nature of the course allows a cross fertilisation of learning styles and working methodologies. The staff within the studio are multidisciplinary in nature and are all originally from industry, with expertise in graphics, animation, product design, Web design, film making, computer game design, and technical programming and systems support.

To support students in devising and creating such a diverse range of outcomes, a number of educational and technical strategies have been developed. To ensure the necessary level of detachment and objectivity, the programme includes a research methods programme in which students are required to explore in detail the subject matter of their proposal and acknowledge the work which has preceded them in this area. Secondly, they must describe, through aims and objectives, the intention behind their proposal, taking into account the market for which it is intended. Formulating an appropriate technical strategy is vital to avoid needlessly carrying out unproductive work. Classes in storyboarding and critical precedents from film and TV are offered, the latter to provide a broad operational context.

It is recognised that teaching advanced software is time consuming and demanding, and that it has the potential to confuse. To overcome these problems, software workshops are followed with discussion "clinics" where students can informally seek guidance and support from various staff members. Of great importance, however, is the ability of the students to inform one another and introduce different patterns of thinking when engaged in project work. This is specifically encouraged through the medium of a student-led 3D forum where they discuss and show the work they have created.

## Research

Physically adjacent to the masters studios are the research environments where the research focus represents the leading edge of digital 3D activity and is conducted in collaboration with several major companies. The benefits to students and their own individual programmes of study are immense, with many individuals or small teams being involved where appropriate.

### Two main areas form the core of research activity:

1. Leading-edge product integration of new 3D digital technologies that support fundamental levels of the human computer interface. This research involves real-time advanced 3D visualisation techniques supported by gesture-based control, haptic feedback, and 3D audio rendering cues.
2. Development of virtual digital prototyping based on researched 3D reconstruction of objects, scenarios, and environments, permitting subsequent interrogation and interpretation of data.

Examples of research undertaken or still in progress range from virtually prototyping and animating early gliders in the quest for powered flight to development of new 3D workstations for automotive design.

## Training

In addition to disseminating advanced technology to industry, training activity serves as a vehicle for obtaining feedback into research programmes on areas of new design methodologies and human-computer interaction. The proximity of industrial users to the masters students permits a merging of learning and organisational issues, an important element in the overall development of the studio's ethos. Similarly, leading-edge research undertaken in the studio directly supports special training activities.

The essence of the above mix of education, research and training is to ensure the maximum cross fertilisation and exposure between masters students in the education programme, industry in the training programmes, and research activity undertaken for major UK and international companies.

## The Digital Design Studio Environment

To energise all of the above consistent with the high level of achievement anticipated, an exceptionally well-equipped studio had to be created. Paradoxically, the studio's location was to be another Charles Rennie Mackintosh called The House for an Art Lover. This building, although designed in 1900, was not built until 1995, and the Digital Design Studio was housed in the upper floors of this magnificent Art Nouveau building.

The studio currently has 40 SGI workstations ranging from Windows NTto O2s, Octanes, Origin 200, and ONYX IRs. Students have guaranteed access to a machine at all times. Other highly specialised items of equipment include the world's largest virtual reality table; a Fakespace Immersive Workbench; a Visionmaker digital draughting tablet; a Lake 3D audio system; a Monkey 2 skeletal animation system; haptic devices comprising gestural, touch and force feedback; and a Microscribe 3D digitiser. The studio also has a sound suite running Pro Tools and Logic Audio networked to video editing facilities. The nature of the agreements with SGI and Alias|Wavefront ensures that the studio is maintained at the leading edge in both hardware and software provision.

Much thought went into the layout of the studio to make the interplay of different facets visible, whilst at the same time acknowledging discreet activity where appropriate. The obvious consequences of research activity required a high degree of confidentiality, and the main research studio has access by security door entry systems. Confidentiality and non-disclosure agreements became a part of everyone's life in the studio (a reality of the world we live in).

From the foregoing, it will be seen that the studio has been designed to ensure the maximum physical and intellectual interplay among each of the three areas and to provide a highly charged learning and research environment. The operation of the studio does not follow the typical academic model. Its flexible hours and emphasis on the critical importance of deadlines more closely resembles the industrial model.

## Case Studies

In the second year of the masters programme, students engage in their own individual small-scale research programmes. This requires elements of the students'first-degree expertise to be exploited through their newly acquired skills in 3D visualisation and animation. The following four examples are typical of the diversity and type of subject investigated. It should be said that in each of the cases cited below, the student had no prior experience of 3D software. The work was created using Alias|Wavefront Power Animator and Maya.

### Martin Usborne (psychology graduate)
*Investigating the Nature of Digital Space*

This submission was essentially an argument for a new perception of space through digital technologies. Usborne looked at precedents from film, theatre, and the painting tradition, and in particular at examples in which space is treated differently. The work of the German Expressionists, the theatre of Brecht, and paintings of Magritte formed part of his survey. This resulted in an exploration of digital space through two set pieces:

*1. Abstract Spaces*
Spaces that have only a vague sense of existence explored through light, movement, and shaders.

*2. Momentary Architecture*
Spaces that exist within a moment frozen in time. Porcelain plates are suspended from the ceiling of a cold, hard-floored room. As the plates drop to a shattering conclusion, the animation is stopped, and the spaces are explored (see Figure 1).

### Brian Robinson (mechanical engineering graduate)
*Visualisation for the Offshore Industry*

Robinson started by looking at the current use of advanced visualisation technology in the offshore and marine industries and to suggest and demonstrate future developments in this field. He concluded from his research into the current use of digital animation that the most credible use of visualisation software in the marine and offshore industries was in training and simulation, and in particular, subsea visualisation. Based on construction drawings supplied by the manufacturer, a subsea plough used to lay transatlantic cables was built, and the sequence showing its descent to the ocean floor animated.

### Alex Horton (product design graduate)
*Avatar Choreographer*

The object of this project was to produce a set of avatars that were correctly animated, optimised for real-time, and viewable through a VRML browser. Horton looked at emerging 3D shared spaces on the Internet and considered these in relation to the pioneering principles laid down by computer games. Horton used dance as an appropriate medium for animation because of the potential for social interaction and as a test of character design by virtue of the poses it offered with the normal walk, run, wave set of gestures. Break dance, folk dance, and rock n' roll were studied. The outcome was the creation of VRML avatars capable of performing a variety of dance moves (see Figure 2).

### Tom Marshall Andrews (product design engineering graduate)
*Bus Transportation Interface, in conjunction with DERA*

Although it is part of the UK Ministry of Defence, DERA has promoted new products, materials, processes, and advanced technical development leading to many major technologies used worldwide in everyday products. Based on its significant scientific, technical, and engineering experience, DERA recognised the need to build rapid and convincing digital prototypes which could be seen operating in context, albeit virtual. Working with DERA, Andrews's concern was to prototype product concepts based on a new type of display material with unique operational characteristics. Once the concepts were prototyped, the key to further development was to concentrate on the whole user experience and promote the product in a "real-life" environment. This was achieved by shooting video of a real streetscape complete with bus stop, traffic, passers-by, and a typical user, who would go through the motions of interacting with the new product.

After the prototype was modeled in 3D, it was carefully composited into the scene. The bulk of this digital mock-up still had to have the very necessary visual cues that would, in essence, bring the product to life. These subtle, but important, cues simulate the sensory cues that we experience in our everyday lives.

The time required to produce this type of high-level presentation is short, which gives fast concept studies, market surveys, or customer focus groups a real benchmark in terms of feedback and interpretation. Yet many organisations choose not to use this approach. It is important to realise that nothing was produced physically. This must beg the question: Do you present virtual products and only produce what you have orders for?

## New Research Areas

The small-scale research projects undertaken by multi-disciplinary masters students have contributed to the overall research profile of the studio. As evidence of this, the studio has recently been awarded a £1.1 million ($US 1.76 million) research grant from the Engineering and Physical Sciences Research Council to look into the use of advanced 3D displays in selling automobiles. This is the first time that research projects have been funded by this research council in an art and design institution in the UK. This in itself is an example of the growing interest in the sensibility that such institutions can bring to "hard" research issues. This research, entitled Supporting Customer Interaction, Feedback and Information (SCIFI), seeks to develop interactive 3D displays and sound systems, which will allow the public to engage in pre-sales interaction with realistic and credible computer-generated models, resulting in a fundamental reassessment of the way in which cars are sold. As such it is the culmination, to date, of the distinctly multidisciplinary ethos promoted within the studio.

In carrying out this research, the studio will be concerned with developing future interactive selling strategies in which advanced 3D computer modeling and virtual environments with touch and sound cues, together with communication technologies, will allow new and imaginative sales scenarios to emerge.

The present method of selling cars requires investment in a physical showroom, which nevertheless carries limited stock. In addition, the showroom environment can be pressurized and sometimes driven by what the sales person needs to sell rather than what the buyer wants. The challenge presented by this research is to present complex information for easy public access. This can be achieved through a non-technical, non-intimidatory approach, thus encouraging a greater degree of social inclusion.

It is hoped this research will identify appropriate visualisation technologies, which will fundamentally improve communication processes between customer and manufacturer. In turn, this will result in the public having access to information of a qualitative nature delivered in a visually exciting and credible manner. This will enable the manufacturer to move from the present showroom convention to having a "stock list" presence in densely populated retail environments, such as airports, stations, or shopping malls.

## Conclusion

The multidisciplinary approach towards research taken in the Digital Design Studio has, over the past two years, produced some remarkable results that could not have been predicted under the constraints of normal single-disciplinary thinking. It has also contributed significantly to winning funding from a number of industries as well as a major UK research council.

In general terms, it is well established that a group of people from different backgrounds can together act as a powerful lever in imaginatively lifting ideas off the ground. Such a resource provides a powerful think tank, which can solve many problems and generally create a situation in which many approaches and conclusions are possible.

In the context of this paper, the role that multi-disciplinary education can play in new digital industries is recognised. Game companies, Web development organisations, digital online services, film and TV, and manufacturing and visualisation industries demand these empowering combinations. It is the experience of the Digital Design Studio that putting a psychologist together with an engineer, a designer, and a fine artist can lead to wildly exciting, if sometimes unpredictable, outcomes.

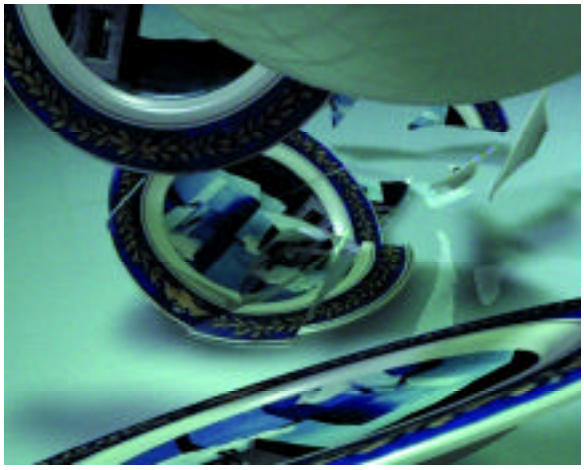

*Figure 1: Martin Usborne's exploration of digital space using porcelain plates.*

*Figure 2: Alex Horton's dancing avatars.*