Go to contents 07

Education for the Virtual Age

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This paper suggests that the theoretic framework devised in the late 1960s to help structure the IT curriculum in Schools of Architecture has served the community of teachers and students well but must be re-visited to take proper account of the recent and rapid developments in Virtual Reality and Real Virtuality. The paper offers definitions which differentiate these terms and suggests that the emerging technologies will have a major impact on the issues of sustainability, user participation and creativity. It ends with an appeal for the discussion of the theoretical and philosophical ideas raised by virtuality, and the development of the skills to test them, to be put at the heart of the architectural agenda and curriculum.
***Keywords**: virtual reality, real virtuality, design theory, architectural curriculum*

Background

The first serious discussion of the deployment of information technology in an architectural education framework can be detected in the earliest meetings of the Design Methods Group in the USA and the Design Research Society in the UK. Both groups – one concerned with researching the complex human activity of design, the other with formalising and codifying the method – affected the commitment and interest of a range of people from a variety of disciplines who appeared to share the view that the design of the built environment was much too important an issue – economically, socially, environmentally and culturally – to be left to the unjustified, if not willful, actions of the architectural profession of the time. The time, of course, was the mid/late sixties and the notion was that people deserved to be offered an explanation of the decisions which impacted upon their everyday life and, even, a role in the decision-making process.

A few of the academics who made signal contributions to the emerging subject area continue to make outstanding contributions today, most notably Nik Negroponte (who dedicated his book, The Architecture Machine, to the first computer which would appreciate the gesture) and Bill Mitchell (currently the most important and prolific author in the field). But there were many more, driven not only to devise a theoretical context in which their work could be judged but also to build, using the most primitive technologies, simple – but none-the-less elegant – prototypes of potentially useful computer-based applications (Maver, 1970).

It can be fairly claimed that the most significant advances in our understanding of the complex human activity of design came about through these early, if vain, attempts to emulate the design activity electronically – echoing a parallel advance in the understanding of human intelligence through vain attempts to create artificial intelligence.

In a number of Schools of Architecture, the theoretic framework devised those 30 years ago has served well as a means of structuring IT teaching and learning. Regrettably however, in the authors' view, the imperative to generate glossy presentation images has squeezed out the use of the computer in the formative conceptual design-making phases in the design process when the all-important relationship between form and function is critical.

The emergence of ubiquitous multimedia technologies and affordable virtual environment capabilities suggests that we re-visit some of the theoretical and methodological precepts underpinning our field of study as a prelude to reshaping, over the next decade, the way we teach and learn how to design.

Hopefully, this paper makes at least a modest contribution to that process.

Some definitions

Our dictionary offers the following definitions:

Real: that which is real and not imaginary; having verifiable existence; occurring in fact or actuality.

Virtual: having efficacy without being material; existing in essence or effect but not in actual fact; a product of the imagination.

Definitions proposed for the purpose of this paper are:

Virtual Reality: Electronic simulation of the form and/or function of a real building which previously existed, currently exists or is intended to exist in the future.

Real Virtuality: Electronic manifestation of an environment which will never be realised, whether in the form of a building or not.

These two subjects are discussed in the following sections of the paper.

Virtual Reality

Current state-of-the art

There is much evidence that virtual reality technologies are contributing powerfully to the evolution of design concepts through interactive appraisal of both form and function.

A companion paper at this Conference – *Educating the Virtual Architect* – describes in detail how effectively the emerging range of VR tools – event managers, touch sensors, proximity sensors, time sensors, sound, in-line objects etc– especially if deployed in a high quality immersive and interactive VR environment, can provide a very immediate and real impression of being "in" the building and make obvious to the designer those aspects of form and finishes which work well and those which don't.

The immediacy and verisimilitude of the experience means that the client/user representative(s) can "accompany" the designer through the building and contribute effectively to the design decision-making process.

VR is also, if independently, making a major contribution to the understanding of how buildings function (Maver, 2000). The ability to simulate, and display dynamically, environmental external wind flow around the building, sunlight penetration into the interior spaces, natural and artificial illuminance, air flow, etc – is leading to highly innovative, high comfort, low energy solutions. Dynamic simulation of the movement of people within a building offers greater efficiency in lift design and control and greater safety in the event of the building having to be evacuated.

The limiting constraints, currently, are:

i. the fact that the software for appraising the form of the building is typically disjoint from the range of software applications for appraising function.

ii. the non-natural modes (mouse/keystroke or joystick) of navigating in the virtual world.

iii. the requirement, when design change is desired, to have to go back to a conventional CAD package interface rather than interact, dynamically, with the virtual world.

Anticipated Developments

There seems little doubt that the pace of development in the field of VR will continue to accelerate, fuelled primarily by the computer games industry. The developments which are specific to the built environment will include the following.

The integration of VR software for form and function

Rapid progress is being made by specialist developers such as Integrated Environmental Solutions (www.ies4d.com), within a conventional CAD environment, to bring a raft of appraisal simulations

into conjunction with modelling and visualisation software packages. The next step is to realise this integration within an immersive VR environment so that the designer/client, when moving through the virtual building, can point to a thermometer on the wall to check the air temperature, point to a window to see the ingress of sunlight throughout any time of the day or the year, point to the fuel meter to anticipate the annual fuel bill, or visualise the dynamic airflow all around. In short, "experience" the functional characteristics of the building as well as its form.

Navigation

The bio-mechanical complexity of human movement is considerable and it seems unlikely that any general purpose motion platform will appear in the near future. It is worth mentioning, however, that in the special case of wheelchair users, a sophisticated wheelchair motion platform has been developed which allows the user to navigate within a wholly immersive VR environment but also provides, via a brake and electric motor, force feed back when negotiating inclines (Maver, 2001).

Design Interaction

The idea of deploying complex haptic devices to allow those within the virtual world to "move" windows, doors and walls is feasible but probably impractical and un-intuitive. The likely scenario is to arrange for the designer, while within the virtual world, to have access, virtually, to her/his workstation and CAD package and, thereby, effect design changes to the environment in real time.

Real Virtuality

The ideas behind Real Virtuality, as it impacts upon architecture can be discussed under two headings: virtual buildings and the architecture of the abstract.

Virtual buildings

Electronic networking is making it possible to carry out many of the functions hitherto located in physical buildings – such as libraries, banks, museums and stock exchanges – in virtual environments. There appears to be a wish on the part of the users of such networks to retain the paradigm of the building as an interface metaphor. There is, then, a need to educate architects to design (and implement without the need for a building contractor) virtual buildings, some of which may be virtual extensions to real buildings.

Within these virtual buildings the normal constraints of the physical world can be suspended and the rich functionality of virtual reality deployed to advantage of the building "inhabitants".

It is, moreover, possible to design with the sole purpose of creating a virtual architectural experience as a manifestation of the utopian dream.

> *"The architecture of cyberspace will succeed where modern architecture failed. Utopian architectural imagination is no longer limited by physical reality. Its only limitation is the speed of rendering engines. The dream of transforming people through the experience of space can finally become a reality" (Manovich, 1995)*

Architecture of the Abstract

Perhaps the most challenging task in education will be to prepare graduates to give some visual manifestation to what is wholly abstract – *"an architecture without doors and hallways, where the next room is always where I need it to be. Liquid architecture makes liquid cities, cities that change at the shift of a value, where visitors with different backgrounds see different landmarks, where neighbourhoods vary with ideas held in common, and evolve as the ideas mature or dissolve" (Novak, 1992).*

Impact on the Curriculum

It is suggested that the developments discussed above will have impacts on the process of teaching and learning in three main areas: sustainability, user participation and creativity.

Sustainability

The meaningful integration of visual simulations of both formal and functional characteristics of building performance within an immersive VR environment

offers the potential to address, from the early stages of conceptual design, the complex issue of sustainability in buildings.

User participation

A realistic experience of "visiting" the building while it is still on the drawing board is crucial to the effective participation of client and user representatives; the small amount of evidence currently available suggests that this level of participation will be invaluable in securing a building which is fit for purpose.

Creativity

Innovative use of emerging information technologies has, over the last thirty years, been student-led and never more so than right now. The imaginative use of VR and RV by those students who have access to it is quite extraordinary and will set new ambitions in creative design practice.

There are those who argue that the use of computers in architecture education is now so ubiquitous that we no longer need a class, or classes, devoted to it: we don't have a class in Pencil Aided Design (PAD), so why have it in Computer Aided Design (CAD)? The authors disagree. Just as the early experiments in CAD in the late 1960s brought forward advances in design theory which in turn provided the teaching and learning framework for the following three decades, so the current experiments in the use of VR and RV will require a philosophy linking reality with virtuality which in turn will provide a teaching and learning framework for, at least, the next decade.

The discussion of these theoretical and philosophical issues, together with development of the skills to test them, *must* be at the very centre of the architectural agenda and curriculum.

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