Virtual Worlds for Education and Training

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Introduction

"it is evident that every UK university except one (the University of the Highlands and Islands) has members of staff who have developed, or are developing, something in a virtual world"

– John Kirremuir, Virtual Worlds Activity Snapshot #7 Winter 2009

One of the most significant areas of use of virtual worlds is proving to be in training, education and learning. Virtual Worlds Watch [KIRREMUIR2009] estimates that over 95% of UK Universities are now using or experimenting with virtual worlds, principally Second Life (SL), and the SLEducation Wiki lists over a hundred US educational institutions in Second Life. We are also seeing activity amongst Further Education (FE) colleges (e.g. Barnfield College), and both Secondary and even Primary schools. In the adult sector large multinationals like BP and Cigny are using virtual worlds to educate their employees, and hospitals (e.g. St George's London, Governments (e.g. Canadian Border Security) and the Military (e.g. USAF MyBase in Second Life and TRADOC in Active Worlds being just two of many examples) are also exploring the use of this technology.

The aim of this white paper is to outline why it is that virtual worlds are sensible places to be doing education, training and learning, and what you need to think about if planning to use them to support your activities in this area. We will also provide some frameworks to help educators and trainers understand how virtual worlds can be used within their fields.

Throughout we are conscious that both public and private sector organisations are facing significant pressures to cuts costs and do more for less. As such we realise that any training or education organisation is only likely to invest in a new system if it enables them to deliver either:

- the same quality of learning/training for less cost, or
- a higher quality of learning/training for the same/affordable cost

In this document we will use the sidebars to present case studies drawn from the work of Daden clients and other thought-leaders within the virtual world space, and to examine particular issues or topics in more detail.

Virtual World Platforms

The table overleaf summarises the platforms typically presented as virtual worlds, and which we believe are suitable for enterprise use. Note that there is a distinction between the technical platform which creates a virtual world experience, and how a virtual world experience is presented to users. For instance the Second Life platform can be used to create as diverse experiences as a paramedic trainer, an air-traffic control visualisation tool, a building consultation tool and a shared social entertainment and leisure experience.

In this paper what we are really interested in is how virtual worlds technology can be used fundamentally to provide a 3D user interface for learning experiences - what that experience is designed to achieve is solely at the discretion of the builder or tutor.

To us this is a vitally important distinction which is lost on many potential users. The virtual worlds we are interested in are purely tools you can use to build the environments you want to create for the task at hand. Whether you, or your students, also use them as a 3D social network is a completely separate issue.

Defining a Virtual World

First, how do we define a virtual world, and how is such an environment different from a serious game or a Massively Multi-Player Online Role-Playing Games (MMORPG)?

We would define a virtual world as a digital environment, which is completely delivered over the Internet or Intranet, where users:

1. are represented by avatars
2. can interact with each other
3. can interact with and effect their environment in a persistent manner
4. have no more restrictions placed on them than they can expect in the real world
5. can decide from a wide range of actions, or even inaction
6. can build and create within the world, without having to master additional tools
7. can use the world for a wider variety of different purposes

Against these criteria serious games typically fail to meet all but (1) or (2), and MMORPGs typically fail to meet all but (1), (2). Number (6) is probably the most challenging criteria, and is currently only met by two platforms.

"3D environments like Second Life can be valuable tools [for learners]" – Andy Harris, HM Inspectorate for Education in Talisman, Dec/Jan 2010

World/Owner	URL	Description
Alpha World *Active Worlds Inc*	www.activeworlds.com	Pre-dates all the other so simpler graphics, but has good user interface (UI) and programmability, and relatively low bandwidth/graphics requirements
Olive *SAIC*	www.saic.com http://www.forterrainc.com/	An "enterprise" solution with many Global 500/Government users, recently acquired by SAIC in their takeover of Forterra Inc.
OpenSim *Opensource*	www.opensim.com	An open-source version of Second Life, still in beta
Protosphere *Proton Media*	www.protosphere.com	A relatively new entrant aimed at the Enterprise space
Second Life *Linden Lab Inc*	www.secondlife.com	Both a consumer world (Second Life) and increasingly an enterprise solution (Second Life Grid/Project Nebraska)
Teleplace *Qwaq Inc*	www.teleplace.com	A meetings orientated virtual world (or virtual meeting room to be precise)
Vastpark *Vastpark Inc*	www.vastpark.com	A relatively new entrant, recently placed its code in open source
Web.alive *Avaya*	www.projectchainsaw.com/WaStore/	A browser based solution from Nortel, more an engine than a virtual world. Just sold to Avaya.
Open Wonderland *Open source*	http://openwonderland.org/	An open source virtual world written in Java. Was supported and promoted by Sun, but Sun support was discontinued after their takeover by Oracle. Now a community project.

Daden produces a more in-depth analysis and comparison of these virtual worlds in the "Choosing a Virtual World Platform" guide which is available to Daden consultancy clients.

Our personal preferences are shown in the sidebar, but each virtual world project should really aim to make its own choice based on its own needs and constraints.

Why Second Life/OpenSim?

For us Second Life (or the open source OpenSim variant) is probably the best choice for 90% of virtual world projects. Why? Well primarily because it is the only one offering reasonable graphics with in-world building tools, and as a result high levels of flexibility. Active Worlds does offer in-world building, but the graphics see very basic by today's standards. Second Life also has the most active user community – and so sees very high levels of innovation. If the shared hosting of the Second Life main or Teen grid are a blocker to adoption (or there is a need access across the age 18 divide) then Second Life Enterprise (Second Life behind the firewall) or OpenSim may be a solution.

Southampton Solent

Southampton Solent Universities first move into Second Life was based around a requirement to provide their fashion students with greater opportunities to plan cat-walk shows, and to experience some of the commercial issues of running a fashion business. Daden built a virtual cat-walk, complete with lighting and sound effects on which the students could practice putting together shows before the limited time they had on a physical cat-walk.

We also built a small retail where students could set up their own fashion shops, selling digital copies of their fashions to other avatars using Second Life's in-built e-commerce system.

PREVIEW Project

Daden worked with both Coventry University and St George's Hospital, University of London to develop problem based learning scenarios in Second Life as part of the Joint Information Systems Committee (JISC) project. With Coventry University the focus was on inter-personal interaction within care-home management, so we used our automated avatars to create a variety of situations which the students could interact with.

With St George's the emphasis was more on procedural based simulation to train and assess paramedics. We developed a system which used the Medbiquitous Virtual Patient (MVP) standard to create and manage scenarios on the web, but to play them as fully immersive experiences in Second Life. This system has since been released into Open Source as PIVOTE, a web based system which can be used to author a wide range of exercises for any subject on the web but play them in multiple virtual worlds

See www.daden.co.uk/pivote for more information.

"In about three years, we will see the widespread availability of robust and easy to use authoring tools and environments, mostly with the functionality described in the upcoming The Complete Guide to Simulations and Serious Games (and foreshadowed in PIVOTE)...This is a big step"

– Clark Aldrich Brandon Hall Research, Virtual Worlds, Games, and Simulations: The Challenges of the Next Five Years 2009 [ALDRICH2009]

Ways of Using Virtual Worlds

We have identified five broad ways of using virtual worlds for learning. Whilst in some ways these may represent a maturity ladder, there is no explicit progression and use at any level is valid at all times.

Summary	Description
Remote Learning	The virtual world is used as a remote working/learning/collaboration space only. Real world activities such as speech, text chat, Powerpoint, posters, whiteboards are the predominant means of interaction/teaching learning, and it may include team-building, or even team building (with prims!).
Exploration	The virtual world is used to create a predominantly passive environment or exhibit which the user explores in the same way that they might explore a museum (or even living museum), or historical site. The information is communicated by the environment either visually, via text or other multimedia and is passively consumed by the user. The user is "outside" the activities although they may have an influence on them
Visualisation	The virtual world is used to visualise a process or set of data which the user then explores, or uses as the basis for further analysis or decision making
Simulation	The virtual world is used to create a simulation of the real-world in which the user is a key player
NPIRL	The virtual world is used to create environments which would just not be possible or safe in real life, from "grand simulations" like walking on the moon or inside a volcano, to impossibilities like exploring the inside of a cell or flying through clouds of data hanging in space.

For all but the first there are two modes of delivery:

- where the world is just used as a visual-aid, with the teacher using it purely for demonstration (so the whole audience may be physically together looking at a single projection screen),
- where each member, or groups of members, of the audience is controlling their own avatar and is an active participant in the world.

It should be noted that these levels are by no means clear-cut, but rather represent points on a continuum from "glorified IM/audio conference" to complete fantasy environment.

Our feeling is that some 50% of current education/training projects in Second Life are only at the Remote Learning level, 30% at Exhibition/Visualisation, 15% at Simulation and 5% at NPIRL.

Why Use Virtual Worlds?

We have identified 6 areas where virtual worlds can help deliver better or cheaper learning – or both. They are:

- Supporting distance learning
- Changing learner dynamics
- Delivering better learning & retention
- Gaining a subjective view
- Reducing costs
- Doing the impossible

For an alternative view look at the Benefits of Virtual Learning sidebar.

Benefits of Virtual Learning

Writing in the British Journal of Educational Technology (Jan 2010), Dalgarno and Lee [Dalgarno2010] identify 7 learning affordances of 3D virtual environments:

- Facilitating learning tasks which lead to the development of enhanced spatial knowledge representation
- Facilitating experiential learning tasks which would be impractical or impossible to undertake in the real world (including simulations)
- Creating simulation of abstract environments which embody concepts and principles which are not normally accessible to the senses (via Winn & Jackson 1999, also referred to as microworlds)
- Facilitating learning tasks that lead to increased intrinsic motivation and engagement (due to high levels of personalisation and immersion and being "in the flow")
- Allow learners to approach concepts as "first-person non-symbolic" experiences, in contrast to most instances in which information is codified and represented "third-person symbolic" (via Winn 1993 and Dickey 2005)
- Facilitating learning tasks that lead to improved transfer of knowledge and skills to real situations through contextualisation of learning (i.e. learning in an appropriate realistic simulation)
- Facilitating tasks that lead to richer and/or more effective collaborative learning (due to the 3D social interaction and negotiation)

- Supporting Distance Learning

Even with conventional presentation based teaching virtual worlds can be the ideal way to support distance learning students. Unlike impersonal, asynchronous discussion boards, or disembodied conference calls, or technically complex web-meetings and video conferences, virtual worlds can allow students and teachers to meet virtually in avatar form, wherever they are geographically. The participants can still use speech for the primary discussion, but text chat provides a rich and public back-channel, and conventional teaching materials such as Powerpoint and video can be used.

Indeed in our experience remote learning can lead to better outcomes than a classroom session. For instance in one project the students had been used to role-playing customer services scenarios in the classroom; but the exercise was never fully successful as the students could see one-another and the tutor during the role-playing. In the virtual world, however, not only were the students working in immersive simulation of a retail shop, but the students' and tutor's avatars were dressed according to their roles. Even though the students *knew* the avatars were being controlled by their colleagues the lack of immediate visual confirmation of that allowed them to better "suspend belief" and engage with the learning situation.

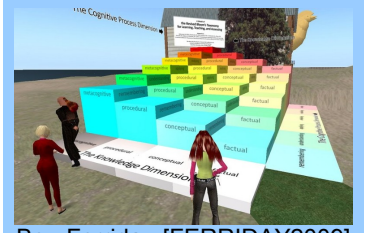
- Changing Learning Dynamics

Much of the early use of virtual worlds for teaching just leveraged the fact that a class had a different dynamic when the participants were represented by avatars (of varying sex, species and dress-sense), gathered round a virtual camp-fire on a virtual tropical island. Not only does the setting change the mood (possibly encouraging more creative thought), but studies also suggest that since the brain stores memories based on ambient factors [CLARK2003] then just changing the meeting location each time can help better imprint the topics discussed.

Also important is the fact that students have both speech and text chat available to them. This means that it is far harder for one person to dominate, and that quieter students can come more to the fore (both by being able to "talk over" a dominant character in text, and by feeling "safe" behind the front of their avatar). Removing typical fears and anxieties generated in a more traditional classroom environment. This has been a common finding of many vLearning studies [e.g. MARTINO2007].

Finally the persistent nature of the virtual environment "allows for continuing and growing social interactions, which can serve as a basis for collaborative education" [FALLON2010] . Indeed "cyberspace can act as a support for particular social activities and relationships, rather than acting as commonly thought as a substitute for real experience" [WOOLGAR2002].

Bloom's Taxonomy



Bex Ferriday [FERRIDAY2009] has created a nice 3D model of Bloom's Learning Taxonomy on Cornwall College Island in SL – and also a copy of Wenger's Community of Practice. These are good examples of how a virtual world can take existing 2D information and make them more memorable by creating them in 3D. Students can move about the diagram, voting literally with their (virtual) feet about where they (or their chosen topic) stands on the taxonomy – and so remember the model with their spatial and episodic memory, as well as their semantic memory.

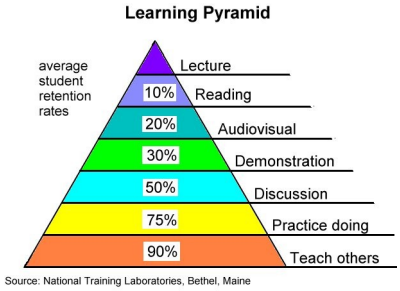
Encoding Specificity

Encoding Specificity is a key concept that lies at the heart of the use of simulation in learning. What learning psychologists and cognitive scientists working on memory have found is that "transfer [of learning] is maximum when the conditions at retrieval match those present at encoding." [CLARK2003]

In English – *we will be better able to remember what we learn, if the conditions during learning match those during recall*. So if we learn about an activity whilst fully immersed in a simulation of the "real" environment that matches the real experience our learning and recall will be better than if we learn by reading books and Powerpoint in a sterile classroom and then have to perform in a noisy factory or a busy street.

- Better Learning & Retention

Many readers may be familiar with the "legendary" NTL [WOOD2004] hierarchy of learning.



This neatly summarises the typical way that student retention rates vary based on how content is delivered or presented. Virtual worlds are capable of being used in every way – although teaching others is perhaps a bit more challenging given the lack of facial cues that often serve to indicate understanding or confusion. Learning projects that operate at Level I of our classification above are focussed on the top 3 activities. Level II (virtual museums) typically brings in more demonstration, and with simulation (Level III) we move significantly into Practice – so hopefully achieving 75% retention rates.

That such performance enhancements are indeed possible in virtual worlds is borne out by the quantitative and qualitative results of many recent virtual world projects.

Virtual worlds provide us with a relatively simple and cost-effective way of letting students experience and "do" far more things that most conventional technologies. We can immerse them in a human body, or on a building site, or in a Roman city. But does such "virtual" doing equate to physical doing? The evidence suggests that the answer is yes. For example:

- A study by Blitz Games for their Triage Trainer [DEFREITAS2009] showed that students using the trainer did have a higher retention rate than those who learnt conventionally. They found that there was significantly higher tagging accuracy in the game trainees [x^2 = 13.126, $p<0.05$], significantly more accurate (28%) than the non-game group (7%) [x^2 = 7.29, $p<0.05$], and no significant difference in the time taken to complete triage of all 8 casualties.

- A study at Imperial College London [IMPERIAL2009] showed that when medical students used Second Life for their operating theatre familiarisation they were not only more confident than those who received a conventional lecture but were also more confident than those who'd received the briefing in a real operating theatre!

- A Second Life simulation at Loyalist College (Canada) of border crossing procedures for Canadian border officials lifted success scores from 56% in 2007 to 95% at the end of 2008. The success encouraged over 650 students and 8 faculties to explore Second Life." [LINDEN2009]

- The Subjective View

One of the unique features of virtual worlds is the way that you see the world through the eyes of your avatar – not that of someone looking at a PC screen. This sense of immersion gives you a very involved and subjective view of the environment or data, helping you to gain a better understanding and to aid retention. For instance:

- You can visualise a 3D data set and then walk inside it to gain new insights and to better appreciate patterns and outliers – this could be any sort of data from stock market pricing to real-time locations of aircraft around an airport
- You can have a meeting about spatial locations (be they depots, cities or volcanoes) while walking over a map of those locations – and remembering what was said by which feature the speaker was stood by
- You can change your avatar to almost literally put yourself in a customer (or colleagues) shoes and experience what it is like to inhabit a world or take part in a process "as them"

- Saving Costs

The second main justification for using virtual worlds is to deliver cheaper training.

With remote learning activities the focus is on reducing training costs through reducing the financial and time costs of moving students from their place of work/learning to the place of instruction. This is more important for enterprise rather than academic learning where learners are more likely to be located in offices or depots spread across the country (or even globe). Bringing them into a central point to receive a set of PowerPoint slides and join in discussion groups can be very costly. Simple maths can soon show the benefit of virtual worlds. For instance IBM [LINDENLAB2008] *"estimates the ROI (Return On Investment) for the Virtual World Conference was roughly $320,000 and that the Annual Meeting was executed beautifully at one-fifth the cost of a real world event."*.

We often resort to lecture presentations and PowerPoints because "doing" the real thing would just cost too much, or their just aren't the staff or resources (due to cost pressures) to support it. By doing the activity virtually we may have a greater initial set up cost, but in the long term repeat running costs can be minimal. Whilst we would not want cost considerations to drive out all physical world face-to-face and practical training they can provide a useful adjunct to help tight budgets to that little bit further and help us regain that "doing" retention bonus.

With simulations the savings come from a cost comparison between doing things virtually as against physically. For instance to do a "Virtual patient" exercise in the physical world involves hiring actors to act as patients, using cosmetics to simulate wounds, setting aside rooms for the simulation, and providing staff to mange both students and actors. Every time you do the exercise the costs will be almost exactly the same. In a virtual world you can create what in many ways is a more realistic exercise – a street-scene complete with ambulance, crashed car, pedestrian bystanders etc will have none of the logistical issues of a real-life simulation. And you can re-use the same scenario time and

Six barriers to innovation in learning and teaching in MUVEs

Steven Warburton of King's College [WARBURTON2008] wrote an interesting piece on the barriers to using virtual worlds in education. He identifies 6 main barriers:

- Technical - machine and human related [and standards related]
- Identity - the tension between playfulness and professionalism
- Culture - reading the codes and etiquette of the virtual world
- Collaboration - building trust
- Time - even simple things take time
- Economic - nothing is for free

But strategies are developing to address each of these – from improvements to the client to reduce technical issues, through reductions in time and cost from greater experience and pre-built solutions, to avoidance of culture issues from stand-alone solutions.

eLearning Principles

In 2003 Clarke & Mayer [CLARKE2003] wrote a well received book entitled "eLearning and the Science of Instruction".

Although aimed at 2D web based eLearning systems (and a feel of 1997 about it), a lot of their guidelines are equally applicable to 3D environments – and in many ways virtual worlds provide a better solution to their issues than the web.

- *The Multi-media Principle* – use words and relevant graphics, rather than words alone
- *The Contiguity Principle* – place corresponding words and graphics near each other
- *The Modality Principle* – Present words as audio rather than as text
- *The Redundancy Principle* – Presenting the same content as words and audio content can hurt learning
- *The Coherence Principle* – Adding irrelevant interesting material can hurt learning
- *The Personalisation Principle* – Use conversational style and virtual coaches

In particular Clark and Mayer concluded that "*Practice makes Perfect*" and that:

- "learners benefit from periodic opportunities to practice in *job relevant ways"*
- "interactions should mirror the job"
- "critical tasks require more practice"

time again for minimal (or even no) extra cost. You can also create exercises which whilst physically possible in the virtual world may be just impractical in the real world for reasons of cost or time (like flying your film-crew students to an oil-rig to assess the health & safety implications of using the location as a film set – and all within a 2 hour lesson).

The commercial sector appears to be better at tracking ROI for virtual world education than the academic sector. Such as:

- The Highways Agency saving around £65,000 for each day of training they did in the virtual world instead of in RL [SGI2009].

- US enterprise training consultancy ACS using Second Life and the Forterra Olive platform with blue-chip clients including IBM [BADGER2008]. They report that *"we have determined an opportunity for a positive return will be when companies are able to amortize their 3D world development costs and leverage their monthly user costs against travel savings for multiple classes... the hard cost of one face-to-face class in the real world could be a minimum $1,000 per participant for a one-day class*. Additionally, there is the soft cost avoidance by minimizing the time participants are away from their work since the travel time and stress is diminished."*

*This cost is based upon information received from clients for an average, major U.S. city hotel cost of $140 per night for a two night stay and an average U.S. airfare of $510 (non refundable, weekday travel) plus meals, tips, etc for 16 people would be $15,000."

An added benefit of the cost-saving build is also that it can become a 24/7 resource, rather than something that is only available during lesson time. For instance in the PREVIEW project [PREVIEW2008] the students thought that as well as using the simulation as a teacher directed assessment aid, they could also use it as revision aid for the night before the exam!

- Doing the Impossible (or too costly/infeasible)

Only virtual worlds let you hold a genetics class sat on the bases of a strand of DNA, or literature class in Shakespeare's Globe, a science class on the moon or a motor servicing class inside an engine block. More mundanely few schools or businesses could fly their language students to France every lesson, but all could log into the French speaking part of Second Life. Virtual worlds let us create environments that would just be too costly, unsafe, impractical, or just physically impossible to do in the physical world.

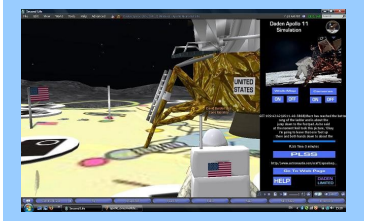
- Supporting Different Learning Approaches

Whilst there is some debate about differences between learners in terms of their preferences for reading, listening, discussing or doing there is no doubt that people have different preferences about what and how they learn diverse topics and in different situations. Virtual worlds are probably unique in terms of eLearning technology in that they can accommodate all learning styles [FOREMAN1999]. For instance a virtual learner can:

- Read text within the virtual world – be it through virtual books, or museum-style display boards, or "data gardens", or simple web pages and text documents brought into the virtual world

- Watch and listen to a presentation or demonstration – either given live by another avatar, or recorded on a robotic avatar or as a video feed from the real-world, or a pre-recorded video
- Discuss with each other by voice or text chat – virtual worlds are inherently social spaces
- Act and do – immersing themselves in simulations of the real world at any scale

Apollo Simulation



North Lanarkshire Council were looking for an innovative vLearning application to showcase the capabilities of virtual worlds on their new Second Life island. Daden delivered them a simulation of the Apollo 11 moon landing. But rather than being just a simple "bounce around on the moon" simulation this was a fully immersive exploratory environment.

Dressed in spacesuits (with sound and motion effects) visitors could switch on an overlay that showed the exact tracks followed by Armstring and Aldrin as they worked on the moon. At selected points the Head-Up Display would show the actual photos (and even videos) taken from the point where the learner was standing – helping to place material in context far better than any diagram. Each piece of scientific equipment could also be touched to bring up images, a description and a link back to a relevant web page.

And at the end of the visit a touch of the LEM would sent it back up to orbit.

Fidelity

One key question when deploying a vLearning solution is what level of fidelity is required – i.e. how closely should the experience resemble real life. In the 1980s when virtual reality was all the rage there was a huge focus on fully immersive high fidelity – within the limitation of the technology then available. Most Virtual Reality (VR) systems came with head-mounted 3D displays and tactile gloves. Since then the focus has switched to a more emotional interpretation of immersion – a teenager playing Grand Theft Auto is probably far more immersed than those 80s pioneers.

Professor Bob Stone of University of Birmingham has a model of fidelity [STONE2008] which can be useful in assessing the correct platform and approach to a vLearning application. He identifies 3 areas in which fidelity of a simulation can be measured:

- How lifelike the context/environment is (which may include the user's avatar, although others [DALGARNO2010] separates this out as a separate area)
- How lifelike the task (i.e. processes and procedures) are
- How lifelike the actual user interactivity is

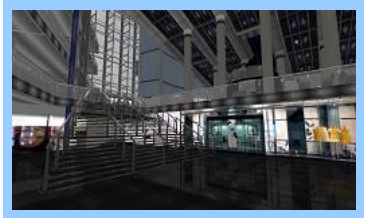
For most virtual worlds the emphasis is on task fidelity rather than on environment or interaction. Top level game engines and some dedicated simulation solutions do score highly on environmental fidelity, and for interaction fidelity you really need haptics or other advanced input devices. By focussing on task fidelity you can make sure that you get maximum value for money – as long as the level of environment fidelity is sufficient to deliver an adequate sense of immersion (and not to detract from the simulation), and interaction fidelity is covered by more specific (and often cheaper) physical world training (eg practising doing IV injections on an orange!).

Exemplar Learning Projects

Whilst we'd like to think that our projects are good examples of the use of virtual worlds for training and education there is no doubt that there are others out there doing great things. Here are some of our favourite non-Daden projects in virtual worlds (all SL unless otherwise noted):

- Theatron – a Kings College project to use SL to visualise ancient theatres for theatre studies students [THEATRON2009]
- Various medical projects at Imperial College (hygiene - [TORO-TROCONIS2008]), University of Sunderland (midwifery) and Ohio State University (doctor-patient interviews - [DANFORTH2009])
- Play2Train's emergency preparedness sim for the state of Iowa [PLAY2TRAIN2009]
- The SL Ecosystem virtual ecology on the Second Nature 2 sim [SLECOSYSTEM2007]
- The Globe build by the SL Shakespeare Company [SLSHAKESPEARE2008]

Birmingham City University (BCU)



BCU currently trains film students on the Health & Safety issues of a shoot by having them set up shots at their Millennium Point campus building. The problem is that the constraints of lesson time and cost limit the students to the area around this one location only. By recreating the location in Second Life we could create a virtual version of the same exercise. Having validated this against the physical exercise BCU are then free to create very different virtual environments for the exercise, letting students deal with Health & Safety problems just not found on campus.

- Dr Doug Danforth's human testis walk-through [DANFORTH2008]
- Derby University's virtual quarry site for Health & Safety training [DERBY2010]
- Teeside University's midwifery simulations by Kate Boardman [BOARDMAN2009]
- University of Ulster walk-through computer [ULSTER2009]
- Open University's First World War immersive poetry archive [OU2009]

Authoring Tools and Building for the Future

One of the biggest decisions facing an organisation moving into vLearning for the first time is the decision about which virtual world to use. At the moment (Apr 2010) there are multiple virtual worlds which can be used for vLearning, but no clear winner and no common standards. As a result there can both be concerns over the safety of any investment in a particular world, and a potentially a significant training requirement for eLearning support staff and domain experts/content authors as they need to learn a completely new set of tools.

An alternative to creating exercises purely within a virtual world is to make use of authoring tools which are PC or ideally web based, and which can support more than one virtual world (and ideally non-virtual world environments as well).

Under the JISC funded PREVIEW project Daden and St George's University of London developed the open-source PIVOTE vLearning Authoring system. This is a web based application which lets authors create the structure and non-3D content of a training exercise on the web, and then allow users to “play” the exercise in a virtual world, or even on the web or a mobile phone. For each environment all the developers have to do is create the visual interface – be it 3D objects and environments in a virtual world, or HTML or Flash on the web or mobile phone.

This approach has three major benefits:

- For the institution the investment in the exercise is largely protected from any future technology changes since at best all that needs to be created is a new user interface within PIVOTE, and at worst export and translate the XML definition of the exercise to a new format
- For the domain experts they can largely create and maintain their exercises just with a knowledge of how to use a web application, leaving only 3D content creation to eLearning specialists
- For the student they can run through the exercise on whatever devices are to hand – be they computers running a virtual world, or in a web browser or even a mobile phone. Of course the level of fidelity and immersion will change with each platform – but the core learning remains the same.

The PIVOTE system also captures all student interaction so that it can be reported back to a Virtual Learning Environment (VLE)/Learning Management System (LMS), and the system also includes a chatbot engine so that dialogues with non-player characters can also be created. There are also plans to create not only a graphic editor for the structure of the exercise, but also a graphic editor for the 3D environment itself.

PIVOTE has now had over 120 downloads of its server code, and we host over 20 institutions on our PIVOTE hosting service, and we've had emails from organisational users as far away as Australia, Canada and Argentina.

There is more information on PIVOTE at www.daden.co.uk/pivote.

Getting Engagement

One of the biggest challenges in developing and deploying vLearning solutions is in getting the engagement of other tutors and staff – rather than just the students. We have found this in our own projects, and it's gratifying when initially sceptical tutors actually engage with the technology and come to see how it can help them overcome some of their own personal challenges with teaching.

[FALLON2010] reports work that he did with New Zealand teachers where *"it was their first exposure to avatars, and it was necessary to establish a soundly-based rationale for their use"*. To achieve this Fallon *"circulated a range of research summaries in advance of the workshops, and the first hour or so in each workshop was allocated to exploring and debating the relevance of concepts and ideas contained in them...Once teachers become involved in reading … it was gratifying to note a considerable change in their attitudes."*

Issues to Consider

In developing a virtual world vLearning exercise there are a number of issues which need to be considered. Some of the key ones are:

- Which virtual world to use – Daden can provide a summary of the key features of each of the "enterprise-ready" virtual worlds. A key consideration is whether you want to allow users (or developers) to be able to create content in-world without using expensive 3D design tools. If you do then the Second Life family is actually the only real option.
- How to host the world – Most enterprise virtual world platforms expect you to set up the servers to host the virtual world yourself. With the Second Life family there are also options to host the worlds with either Linden Lab itself or with a third party provider
- How to "present" the experience – is the learning experience simply a better Health & Safety training system (say), or an adventure in a virtual world which might involve Health & Safety training. User and management) expectation will vary considerably depending on how you present the system.
- How learning is designed – particularly in terms of the pedagogic approach being taken (see Annex A). For instance [FOREMAN1999] sees that *"avatar based environments are leveraged most effectively when they support learner centred teamwork"*, and [FALLOON2010] advocates Inquiry Learning – a constructivist [GIRVAN2009] informed approach to learning in which students have ownership of their learning starting with exploration and questioning and leading to investigation into a worthy question or issue .
- How will users be represented – in a virtual world they can typically not only look like anyone (or anything) but also be called anything. Whilst this may be applicable for some vLearning it is probably not applicable to most. Should users just use their real names and adopt avatars that look like them? There is a lot of current research in this area.
- How differences in learners' preferences will be managed – particularly in terms of the styles of presentation used (micro-adaptation), and even the order of material (macro-adaptation) [DIMITROVA2010]
- How secure does the environment need to be – both from a user point of view (particularly when working with children or vulnerable adults), and from a network perspective. Most virtual worlds can offer behind-the-firewall solutions for ultimate security.

Project Elements

In setting up a vLearning project there are a number of elements that need to be addressed:

- Establishing a clear requirement specification and take a view as to the most appropriate pedagogic approach and virtual learning type
- Being clear as to the benefits expected from the project – both for the learners and the organisation

- Developing a detailed description of the learning exercise from a student and tutor perspective and specifying learning outcomes and any metrics that need to be captured
- Creating the virtual world environment – either by software install or by buying space on a hosted environment
- Creating an induction path to bring students typically from their PC/web/intranet to the exercise location, including an registration required, platform orientation and specific exercise orientation
- Building the 3D environment in which the exercise will take place, including any objects used by participants and including ambient components (including sound and bots) to make the environment seem “alive”
- Coding the exercise itself, ideally in a vLearning authoring tool rather than directly into the world itself
- Putting performance data capture facilities in-place, ideally part of the vLearning tool, and ideally linked back to the VLE/LMS
- Testing the exercise with the tutor/eLearning team, and refining
- Testing the exercise with “tame” students, and refining further
- Producing any supporting documentation required by learners, eLearning staff or tutors

Daden have a vLearning Planning Guide which outlines each of these steps in more detail, and provides an idea of cost. Please contact us if you'd like a copy.

Integration with LMS and VLEs

To support both off and on line learning recent years have seen the emergence of (usually web based) Virtual Learning Environments and Learning Management Systems (VLE appears to be a UK/education term, LMS a US/training term). The aim of these systems is to manage the learning experience in terms of registering students, giving students access to course-ware, sometimes creating course-ware, managing discussions and exercise submission, and collating and analysing marks so that tutors can manage their cadre. As a management tool the VLE/LMS should be agnostic as to whether the training is taking place in a virtual world or elsewhere.

For instance SCORM is a US DoD (Department Of Defence) standard (now used elsewhere) for integrating topic specific eLearning packages with an LMS. It meant that you could manage any SCORM compliant eLearning package from your core LMS, having consolidated user registration, content deployment and results capture. However SCORM was originally conceived for individual training on network connected PCs outside of the web. Whilst it is possible to “box-tick” SCORM compliance for a virtual world based training package or system it means little in practice. There now appear to be at least two separate strands of work (ADL and LETSI) aimed at creating a SCORM 2.0 which will both support web content and web services, and virtual worlds.

Despite the SCORM issues the ability to integrate virtual worlds training with VLE/LMS management systems is highly desirable. The Sloodle project has been one example of this, extending some of the capabilities and content from the Moodle VLE into Second Life and OpenSim. Since web services were lacking in Moodle Sloodle has had to take a relatively bespoke approach to the integration – but the ideal situation (and what the SCORM 2.0 initiatives are looking at), is that the VLE/LMS has web services which expose all its functionality (e.g. user registration, content deployment, discussion boards, project

submission, results scoring), enabling us to bring as much or all of this functionality into the virtual world.

Another, related, possibility is how we use the data visualisation capabilities of a virtual world to provide superior analysis and understanding of the data within a VLE. Virtual worlds are potentially ideal environments for visualising multi-dimension data sets, and using data within simulations or models of the real-world world. Both could offer significant advantages to larger education and training providers.

Glossary

AI – Artificial Intelligence
Avatar - A 2D or pseudo-3D representation of a person or character
Flash - A programme for creating dynamic 2D and 3D graphics on the web
HUD – Head Up Display – an overlay on your screen
LMS – Learning Management System, 2D (web) application to manage learners, courses and content
MUVE – Multi-User Virtual Environment (a more "academic" term for virtual worlds)
RL – real life
RW – real world
SL – Second Life
VLE – Virtual Learning Environment, actually an LMS and nothing to do with virtual worlds
VW – virtual world

Beyond vLearning

So far this white paper has talked about why you should be using virtual worlds for eLearning; but the argument is far wider than just training and education. Virtual worlds are fundamentally about social interaction – without that they feel like ghost towns. But social interaction is a key element of many (indeed almost all) activities, including meetings, collaboration, consulting on a new building visualisation, collective visualising rich data sets – all are about people in a shared virtual space.

In our view just as the web has become the predominant architecture model for transactional based systems so too will virtual worlds become the predominant architecture model for real-time social interaction based systems. And just as having one web world has led to considerable savings in application design, development, deployment and training costs so too will having one virtual world underpinning a wide range of business applications lead to similar savings.

So when you are considering deploying your first virtual world solution for an eLearning remember that that same platform could soon be supporting a wide range of other business applications.

Next Steps

If you are interested in using virtual worlds to support the teaching, training and learning of your students, employees and other stakeholders then we would be pleased to provide you with a demonstration of the use of virtual worlds for vLearning. You can also view videos of many of our vLearning projects at http://www.youtube.com/dadenmedia, and read case studies at http://www.daden.co.uk.

You can also email us at info@daden.co.uk, call us on +44 (0)121 250 5678, or of course visit us in Second Life on Daden Prime.

Annex A

Supporting Different Pedagogies

Recent years have seen the rise in a number of pedagogies aimed at moving away from chalk-and-talk and towards more real-world learning styles. Virtual worlds are ideally placed to support such pedagogies in an effective way. The table below summarises some of the common approaches to learning design and pedagogy.

Table 3.1 Theories to inform design (from Savin-Baden, M. (2010) *A Practical Guide to using Second Life in Higher Education.* Maidenhead: McGraw Hill

Pedagogical approach	Related theory	Theorist	Types of Second Life activities that match
PBL Constellation 9 Problem-based learning for transformation and social reform	Critical pedagogy and social action	Freire (1972, 1974) Hooks (1994)	A scenario that prompts students to examine structures and beliefs
Activity-led learning	Complexity model	Barnett and Coate (2005)	Team-led activities such as designing a set for a production of Hamlet
Co-operative learning	Co-operative Education	Heron (1989, 1993) Johnson et al. (1991, 1998)	Defined by team in relation to assignment
Dialogic learning	Community action	Mezirow (1985) Flecha (2000)	Student-led learning teams that focus on discussion and reflection
Action Learning	Change management	Revans (1983)	Group-led discussion and reflection on action
Project-based learning	Cognitive learning theories	Vygotsky (1978) Ausubel et al. (1978)	Tutor-set, structured tasks, such as building tasks

Pedagogical approach	Related theory	Theorist	Types of Second Life activities that match
Inquiry-led learning	Discovery learning	Bruner (1991) Dewey (1938)	Students decide on their own about issues that emerged during a practice or fieldwork component of their course, and they set their own objectives as to what they want to learn.
Game-based learning	Experiential learning	Gee (2004) Kolb and Fry (1975)	Trivia games, Role play, Simulations
Leaderless group discussion	Humanism	Rogers (1969)	Student-led discussion

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Further Reading

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