

# Building a Virtual Classroom: The Construction Process

Susan Chard

Faculty of Business and Information technology  
Whitireia Community Polytechnic

## Abstract

*This paper explores the process of designing and building a virtual classroom using a 3D environment building tool. This is part of a larger project to create a virtual education environment to facilitate the communications interactions present in the teacher student matrix, while investigating the role of these interactions in the learning process.*

*There are many initiatives to enable virtual education through connection to online classrooms. For these to work effectively there needs to be more than readily accessible published material taking advantage of the speedy delivery afforded by the internet. The traditional campus facilitates many different types of communication. The classroom and computer laboratory, the cafeteria, the corridors, the libraries and study rooms all provide opportunities for communication interaction between students, between students and teachers, and between teachers. There are many opportunities for casual and formal communications.*

*Research investigating engagement associated with on-line gaming environments highlights the potential for these environments to be used for other purposes. Work in the field of knowledge management and knowledge representation highlights the role of discussion and interaction in the dissemination and acquisition of knowledge, emerging from intranet and virtual workgroup research. This work is applicable to online education and forms the basis for a new type of online education environment facilitating multiple interaction layers for the participants to create a compelling online learning environment.*

## Introduction


Taking learning outside the traditional classroom does not remove the necessity for student teacher communication or the need for student student communication. It does however make it harder to facilitate as the students and teachers are physically separated. The capstone student workplace project required as part fulfilment of the degree requirements for Bachelor the of Information Technology at Whitireia Community Polytechnic is designed to be a mediated experience for the students, an experience supervised and directed by a support team from the polytechnic that provides advice, supervision and assistance. Traditionally this has been supplied through face to face meetings with student teams and academic support people gathering together in either the workplace or at a polytechnic meeting room for regular weekly meetings. The gradual spread of our student projects further away from the polytechnic has introduced a requirement to facilitate the projects from a distance. Of the 2003 projects, two groups were working with clients located in other cities, three groups were working in the clients premises and four groups were working at the Whitireia Development Lab, in total 50% of the project teams were not located at the Whitireia Campus. In addition a

number of the groups that were located at the Whitireia Campus had members who preferred to work as virtual team members from home.

### **The internet as an asynchronous communications medium**

The internet is evolving as a communications medium with new technologies integrating the concept of presence with the information publishing and interpersonal communication features commonly utilised. The standard browser based web provides for multimedia publishing of information using text, image, video and sound, primarily facilitating the storage of information for asynchronous communication as was defined in the original proposal document for a distributed hypertext structure for information management (Berners-Lee, 1989). The standard web browsing interface only promotes interaction between individual people and previously published material.

*“It is an irony of the Web that although numerous people may be in the same virtual place at the same time, an important ingredient for social interaction, web users are never aware of others. In effect, they roam the web in solitude - lone wanderers in a deserted world.” (Walker & Lambert, 1995, p. 9).*

The web also provides a means of asynchronous communication through the use of email. Email was created to send short messages from one user to another, its origin was evolutionary improvement of messaging programs used to send messages between users using a single computer. Ray Tomlinson “improved” these existing message programs to send messages between computers connected through ARPNET by improvements to the local inter-user mail program called SNDMSG. (Tomlinson, 2003). Email has since evolved into instant messaging programs that enable users to exchange short messages  asynchronously and synchronously.

### **The internet as a synchronous communications medium**

The provision of synchronous communication is split between standard browser based applications and single purpose chat browsers. Synchronous communication is still predominantly text based despite the emergence of a number of voice and video chat services, these have not become widespread as the technologies have remained proprietary.

Online gaming environments have evolved from first person computer games using the games program to connect to other computers running the same game through to the internet enabling synchronous communication between connected players. Presence has been successfully incorporated into these online games environments, facilitating a rich social interaction and the building of teams through multilayered communications structures. However the information sharing features of these environments are reduced in comparison with the standard browser based web. The challenge is to successfully merge the information sharing multimedia publishing features of the web with the communication interaction and presence found in 3D gaming environments.

The web has developed from an information publishing space to an interactive communication space. Conversation is fundamentally a social process, it is more than simply an intellectual endeavour, through conversation people create, develop, validate and share knowledge. When conversation takes place in a physical space the speakers notice the reactions of other people present (Erikson & Kellogg, 2001). Conversations in the webspace

are often unidirectional with audience reactions either disjointed in time and space or simply not available. Despite many creative efforts at designing chatrooms, discussion forums, e-mail systems and other similar applications, many of these frequently fail to offer rich and sustained dialogue amongst participants. (Hung & Chen, 2001).

### **Integrating Presence**

The integration of the concept of presence has been proposed to address the failure of environments that facilitate sustained dialog. The concept of presence is a concept separate from emotional engagement and different from imagination. Presence is the feeling we get from attending perceptually to the present world (in both time and space) outside ourselves.

*“Presence is the subjective sensation of being there in a mediated environment yielding a perceptual illusion of non-mediation” (Waterworth, & Waterworth, 2003)*

Presence in virtual environments has been classified into personal presence and co-presence, the perception of being there yourself and the perception that others are there with you (Casanueva & Blake, 2000). Presence integrates the additional perceptual information gained from being there with others, awareness, including additional state information, such as whether others are currently active or idle and the task they are currently engaged in. A simple example of awareness is when using an instant messaging client there is a “buddy list” which lists the user’s “buddies” and their current state as online or offline.

The closer the mediated environment can facilitate the perceptual illusion of being in an external sharable world generating the sensation of being there and an illusion of non mediation the greater the opportunities for communities to form. This research project aims to create a virtual learning environment to support a virtual community of learners which will facilitate the creation of Zones of Proximal Development and promote interactions for learning to take place. Vygotsky proposed the Zone of Proximal Development as “the distance between actual development as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” and further proposed that for learning to take place it requires learners to apply knowledge to problems ,that are in advance of those that they can solve independently, through interaction with learning material, with more advanced peers and with teachers (Vygotsky, 1978). This has significant implications for learning environments to support collaboration as it is through these interactions that learning takes place and it is these interactions that need to be facilitated by the virtual education environment.

*“A virtual classroom is both an instrumental group – in which students and instructors want to accomplish goals – and a community – in which students exchange emotional support, information, and a sense of belonging.” (Hiltz & Wellman 1997 p46)*

Computer games are powerfully motivating digital environments and researchers have investigated how the motivational components of computer games may be integrated into instructional design (Bowman, 1982; Bracey, 1992; Driskell & Dywer, 1984). These studies were conducted before online gaming environments were created and ignore the social contexts of gaming and other more recent developments in gaming. These social contexts add an interpersonal communications perspective to computer games enhancing the potential of

the motivating aspects of the digital environment for educational purposes. The study of online video games has been used to inform the design and development of educational digital environments situating them in rich social contexts (Squire, 2003). The combination of powerfully motivating digital environments with a rich interpersonal communications medium provides an environment that has enormous potential for education and learning.

*“Maximal presence arises from an optimal combination of form and content. The form must provide the means for a convincing perceptual illusion, but the content should be integrated with (and so attract attention to) the form for the illusion to happen convincingly.”(Waterworth, & Waterworth, 2003).*

Contemporary multiplayer online games utilise communicative and social aspects of computer mediated interaction. The interaction forms are actions that can be perceived by the players including interactions between players, and between players and the game software. These interaction forms are used to communicate actions to the players including the initiating user. The interaction forms enable awareness and auralisations within the game environment. (Manninen, 2003)

Even multiplayer online games have fundamental problems in supporting rich social activity. Bowman and Hodges (1999) point out that the current applications within the entertainment sector (i.e., computer games) do not usually require any complex interaction between the user and the system. Although the user may be interacting frequently, the interactions are mostly simple in nature. Application of the Habermas' (1984) Communicative Action Theory (CAT) framework has been used to identify the following categories of interaction manifestations.

*“(1) avatar appearance, (2) facial expressions, (3) kinesics, (4) oculistics, (5) autonomous / AI, (6) non-verbal audio, (7) language-based communication, (8) spatial behavior, (9) physical contact, (10) environmental details, (11) chronemics and (12) olfactics”. (Manninen, 2003).*

The use of Avatars to provision user embodiment within the virtual environment fulfills several functions, including the means of interaction with the world, the means of communication including awareness of others, the visual/social embodiment of the user and the means of sensing various attributes of the world. The choice of avatars needs to be broad to enable different users to choose representations they are happy with. The avatars should be able to convey gestures such as readiness to interact and the degree of presence in the environment for example if the user has been distracted by activity outside the virtual environment. The avatars also should show expression as people supplement verbal conversation with many voluntary and involuntary gestures and facial expressions which convey powerful emotional messages in the conversation. (Benford, Bowers, Fahlen, Greenhalgh & Snowdon 1997). Observations of social interaction within virtual environments have found that the lack of a number of important social cues can lead to frequent misunderstandings between users if there is no gesture based supplementation of the text chat. (Damer, Kekeness, & Hoffman 1996).


## **Software selection**

There are a number of different software products available to create 3D online environments. These range from fully proprietary leased solutions to open standards based solutions. Some of the products available use special browsers and others are accessed through standard web browsers using plugins embedded in standard web pages. There are different levels of

customisation available in the products ranging from those that have a number of predefined objects that can be used for building and those that enable the builder to create their own objects. Some enable the use of third party products. There is a great deal of variety in the facilities for incorporating other media for information content and the methods of doing this. For the purpose of this project it was considered important that continuity of operation be ensured for the duration of the project, a period of at least the next three years, that costs be minimised and the software be freely available for individuals to contribute. The software needed to be robust and able to be used without technology interference through technical problems. The ability to include data storage using a database management system was essential to enable automation of the system. It was also important that the resulting environment be easily maintained and upgraded. A number of different solutions were investigated, before the selection of the final product.

The 3D world technology Adobe Atmosphere will be used to create the basis of the virtual education environment. This product enables the development of rich 3D environments with sophisticated graphics and lighting effects that can be embedded in standard web pages using a free plug-in. The worlds are built using Atmosphere builder software which is available for free 30 day trial download from Adobe. It is a relatively open system, the community server is available under an Open Source license to be hosted on any compatible internet server and the player is freely available, although with the public release the free builder license is limited to a 30 day trial.

Atmosphere worlds can be hosted on any server, worlds can be linked together using teleport links from within worlds, they can also be linked through standard URLs and they can be linked to standard web pages. The worlds can be customized to include automated actions and user initiated actions using Java Script, this enables considerable flexibility in behaviour and animations within the worlds. Live video and audio streams can be incorporated into the environment enabling voice and video presence. Atmosphere is unique in that it enables the builder to create 3D worlds that expand in all three dimensions vertically as well as horizontally and presents very sophisticated graphical environment (Dickey, 2003). The environment is published as a component of an ordinary webpage, this provides a very broad scope for the integration of information with the environment.

Avatars are used to represent people in the worlds, the avatar being used is identified by a URL pointing to the avatar file which is hosted on any web server. Avatars are Atmosphere sub-worlds, these can be created by anyone with access to the builder and as long as the files are hosted on the internet they can be used to represent people in the worlds. There are also third party products available to create avatars and objects to include in Atmosphere worlds. These are the 3D building products commonly used by computer game manufacturers. Avatars can be animated and often show body movements and gestures. This enables a great deal of flexibility for people to create and use individual representations of themselves and communicate using “body language”, people can also create their own worlds as meeting es.

Other commonly used 3D environment software products were considered but were more limited in scope than the Adobe product. The main alternative considered was Active Worlds which enables building to occur only on one plane. Worlds can expand along the x and y axis but not vertically resulting in a low rise world spread out over the supplied plain. All building is created using supplied textures and objects, these are sound plus 3D objects such as waterfall, column and chair. The available avatars are supplied by Active Worlds and cannot

be created by the users. To build persistent structures in Active Worlds it is necessary to purchase "Real Estate" as it is not an open system. The interface is a standalone combined browser builder and the worlds cannot be accessed through a standard webpage. There is no ability to connect to a custom database for users or content as developers have no access to the player.

The other environments evaluated were Worlds.com which is marketed as a license to operate a world on the supplied servers. The Palace which is no longer supported but is available on an as is basis without the server. The servers are run by interest groups and are not freely available. VRML and Shockwave were also considered and discounted as the development task would be much larger. Games engines were considered but presented considerable cost overheads. Adobe Atmosphere was selected as it was the product that was the best match to the requirements offering the most flexibility.

## **Design**

Building an application with this software is a new process as the software was first released in December 2003, and it embodies a new means of interaction using the web. In addition the development of systems for teaching is an area where it has been recognised that a long term participatory approach is essential owing to the level of personal control and "invisible" nature of teachers work plus the loose coupling to organisational workflow (Carroll, Chin, & Neale, 2000). The environment is similar to and incorporates many of the features found in a standard graphical user interfaces, a web based interface and of online multiplayer games. The process followed has been guided by proven usability design principles for Graphical User Interface design and web usability principles. The features of the 3D medium have been taken into account through the inclusion of the principles employed in the creation of online multi user games.

The ten main usability design principles developed by Nielsen (2001) and his colleagues are: visibility of system status, match between system and real world, user control and freedom, consistency and standards, help users recognize and recover from errors, error prevention, recognition rather than recall, flexibility and efficiency of use, aesthetic and minimalist design, help and documentation.

The user interaction in many virtual environments has been characterised as four universal interaction tasks. Navigation or the task of moving through the environment, includes the subtasks of wayfinding the cognitive component, and travel the motor component. Selection, which is the task of choosing one or more objects from a set and is often coupled with manipulation the specification of object properties such as position and orientation. Lastly System control defined as changing the system state or mode of interaction. (Bowman & Hodges 1999).

The principles of game design in 3D worlds include: third-person presentation, discovery and exploration, movement versus animation, player control, the use of maps, the use of "weenies", closed environments, constant positive feedback with sporadic negative feedback, complexity management and slow bullets (Clarke-Willson, 1998). "Weenies" is a rather bizarre term coined by Walt Disney when designing massive 3D environments (theme parks). He suggested it was necessary to lead visitors through the environment the same way one trains a dog, by holding a wiener and leading the dog by the nose (Clarke-Willson, 1998). Disneyland incorporates obvious "weenies" such as Sleeping Beauty's Castle which

encourages visitors to travel from the main entrance to the central hub. A user in a 3D environment should be able to navigate through obvious landmarks. The environment should lead the user through the environment.

Another dimension is the identification of the users needs, which involves identifying the main user activities followed by analysis of the tasks inherent in these activities. Preece (2000) identifies the following common activities in online communities: information dissemination, information exchange, discussion, support, entertainment, and social chit-chat.

### **Building the first environment**

The first trial environment is a proof of concept demonstrating the technical features of the environment, the aim was to incorporate the possible media within one environment to investigate how they worked and to evaluate their potential from a learning teaching perspective. The metaphors chosen are a soapbox and a gallery. A gallery was chosen as one objective of this trial environment to showcase the different media available. Soapbox was chosen as the intention was to use this environment for demonstration purposes to introduce the product to people unfamiliar with this method of web based interaction.

The soapbox has been situated in the base of an amphitheatre with the gallery stepping up as an inverted stepped pyramid. The inverted stepped pyramid shape prevents avatars falling from the objects when gravity is operating on the avatar and losing their location in the environment. For this reason there are also walls that are not easily scaled while gravity is operating on an avatar. The center is open to enable visual navigation.

The gallery features different information media arranged around a level of the gallery, items which have sound associated are spaced to avoid overlaps with more than one audio track playing at once. Video is situated in corner alcoves, animations, text and image based information are scattered around to create a gallery effect, enabling people to browse by moving around in the environment discovering new features without losing their context. This environment has been evaluated using the synthesized heuristic principles for Graphical User Environments, Web Sites and Online multiplayer games.

This environment is designed for demonstration purposes and is being used to gather user reactions, design ideas and activity information to inform the development of the next iteration of the prototype education environment. Third year students have been invited to use it and to develop their own prototype environments. The information gathered will be integrated into a new prototype which will be evaluated through structured observation methods.

Through the development of a multi-user virtual environment for education I am seeking to promote awareness of other people participating at the same time, maximize the available communication channels and involvement of participants. This research project aims to provide opportunities for both casual and formal communication in the virtual multi-user environment to simulate those provided in a traditional campus.

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