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Engaging training simulations for socially demanding roles

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Students in higher education preparing for socially demanding roles often encounter role play as a technique for mastering their future professions. Lawyers have ‘moots’ or scripted court sessions. Medical doctors attempt to diagnose the injuries or diseases simulated by actors.

Some pre-service teachers undertake micro-teaching simulations with peers pretending to be pupils (not necessarily compliant ones). However, this is an inefficient use of learning time for the peers, and work is proceeding to develop virtual worlds in which such training can be conducted with simulated pupils.

This paper describes the development of one such learning environment, and discusses the challenges to be met as this class of learning interactions becomes useful in teacher training.

Keywords: OpenSim, simulated pupils, pre-service teacher training

Introduction

Behaviour management is a foremost concern of new teachers and the schools in which they work. Good behaviour management results in more pupil time on task, and this can be measured with feedback (Hattie, 2009). Pre-service teacher training is often criticised for poor connection between theory and practice (Standing Committee on Education and Vocational Training, 2007). Behaviour management is a particular skill where this connection is crucial. Previous work has already been published in the area of behaviour management in social computing learning environments (Fluck & Cruise, 2008) and the social effects of computers in education (Fluck, 2001).

However, in the context of scaffolded learning in campus-based teaching, it is difficult to give all 250 students in a lecture an opportunity to practice behaviour-management skills. To do so would require 250 classrooms in close proximity to the lecture theatre so that new theory could be put quickly into practice. Additionally the 250 classrooms would ideally exhibit exactly that aspect of behaviour management discussed in the theory session.

These challenges mitigate making good connections between theory and practice, but a virtual classroom can overcome these difficulties. Through the use of OpenSimulator USB, it can be replicated 250 (or more) times with ease, and the behaviour of the simulated 'bot' pupils can be identical in each virtual classroom. Each pre-service teacher would be given a USB stick which when plugged into their computer would provide a 3D virtual classroom complete with furniture, interactive whiteboard and pupils. Copies of the USB can also support skills mastery for online/distance students, by downloading onto a local stick. Using Gee's transfer principle, skills acquired in the virtual practicum classroom will provide an introduction to their effective use in real school classrooms (Gee, 2003). This form of training for pre-service teachers will be analogous to the simulator training used by pilots, surgeons and ship captains.

Class based role plays can be very useful in professional training for socially demanding roles such as teaching, but they are extremely resource intensive. In such simulations of professional activity, some students take on client roles, and one individual acts out the professional character. Peer students who take on client roles obtain a useful insight into recipients of their future professional practice. If they seek to maximise their time in the role of the qualified professional, role-playing as clients detracts from this perspective. Therefore we sought to review existing simulation techniques in higher education, and build upon this experience to provide behaviour management training to pre-service teachers using a virtual world.

Literature

Simulations have the capacity to improve skills acquisition and assist understanding of the inter-relationships between theory and practical reality. Gatto (1993) had the view that students who interact with simulations are "better prepared to perform in real situations than those students who rely on other instructional media, such as text" (p.154). Simulations can also engage learners in experimental and experiential learning that provides an opportunity to reflect on the way the associated knowledge and skills can be used (Brown, Collins & Duguid, 1989). Participation in a simulation allows the trainee to observe the impact of each choice without adverse impact on real people/clients. They have the chance to experiment and explore the cause-and-effect relationships between certain clients and intended service outcomes.

A report requested by the government into the integration of ICT into school practice identified fundamental systemic flaws in the pre-service teacher education system in Australia in terms of developing teacher competence in embedding ICTs in pedagogy and practice. In recommending the way forward, Black, Smith and Lamshed (2009) suggested technology also provides an opportunity to transform the practicum through the use of virtual world simulations so that student teachers are able to experience 'real' teaching situations where newly developing pedagogy could be practiced and assessed. Their report proposed future directions related to a suite of virtual world schools as teaching and learning simulation environments.

Mitchell, Stanelis and Travers (2010, p. 66) mapped teachers' professional development to integrate ICT into classroom practice, and subsequently made the recommendation "that a set of online tools be developed to support preservice education in the use of ICT in teaching. This should include communication tools to share good practice and a real-time virtual environment that presents a range of classroom scenarios which feature high quality use of ICT." While the initial objective of this recommendation was to improve classroom practice with ICT, the suggestion that pre-service teachers have access to virtual classes to improve their training was of more general validity.

But how might this be done? According to Sasso (2006), 'Simentor?' is an authoring application created by Access Technologies Group (ATG) thatallows companies to create e-learning simulations that fit their company without requiring any computer programming skill. 'Social Simentor?', a product based on ATG's Simentor? software, is a program designed to help in the social development of individuals with disabilities. This example shows how a generic 'engine' for creating and running simulations can be tuned to a specific purpose.

The Mekong e-sim[8] was an early online role-play-simulation set in the Mekong region of South-East Asia in which participants learn to balance the social, political, economic, scientific and conservation based development conflicts (McLaughlan, Kirkpatrick, Hirsch & Maier, 2001). It is housed within the institutional

[8] http://services.eng.uts.edu.au/~robertm/mekong/default.htm

learning management system at the University of Adelaide. However, this is a purpose-built simulation for a single specific purpose.

The ‘DeakinSims: Experiences in Learning Experience Design’ project funded by the Australian Teaching and Learning Council has produced a set of simulations for use in business studies, engineering, project management, systems analysis and professional practice. These web-based online activities were built on the LiveSim[9] architecture, an open source project providing the underlying functionality. A character server and text-to-speech licensed software are also required. This combination of technologies is hosted at Deakin University and the platform is offered to other institutions (Cybulski, 2010). Most of the simulations used a talking head metaphor, with the underlying activity derived from a set of state transition tables. To some degree this model might help with training in behavior management, but what is needed is interaction with a group of simulated pupils instead of a single individual.

An online simulation ‘ClassSim’[10] for pre-service teachers was trialed in prototype by Kervin, Ferry and Carrington (2006). The work was funded by the Australian Research Council and used by 186 pre-service teachers at the University of Wollongong. During the simulation the ‘pupils’ facial expressions showed their emotional states, and the pre-service teachers could see samples of pupil work. Overall the simulation helped pre-service teachers better link theory and practice.

simSchool[11] is a classroom simulation that supports the rapid accumulation of a teacher's experience in analysing student differences, adapting instruction to individual learner needs, gathering data about the impacts of instruction, and seeing the results of their teaching (Zibit & Gibson, 2005). The simulation is web-based with two dimensional cartoon characters representing pupils in a classroom. Pre-service teachers can review pupil files, then select learning activities for each pupil as the simulated lesson begins. Interactions are from a menu of behavioural and academic topics. At the end of the ‘lesson’, the pre-service teacher can review a graphical display for each pupil illustrating engagement and internal emotional state. The strength of this simulation is the coherent theoretical background used to determine pupil behaviour to stimuli. A weakness is the stilted conversational style conducted through text alone, and the cartoon nature of visual presentation.

A project currently in train which shows great potential for achieving the desired training result with respect to behaviour management is Virtual PREX[12]. This is being developed in Second Life[13] and will provide a 3D virtual world for pre-service teachers to practice professional experience (also referred to as practicum or workplace learning). Through Virtual PREX pre-service teachers will practise teaching skills prior to practicum placements, use the space synchronously or asynchronously, by themselves or interacting with peers, academics and/or ‘bots, record and play back video ‘machinima’, for self, peer, formative and summative assessment and practise teaching skills with the ‘bots programmed to react to certain triggers (Gregory, 2010). This will give pre-service teachers the opportunity to experience a range of scenarios in a risk-free environment. The strength of this proposal is the three dimensional realism of the virtual classroom scenario, and the capacity for avatars to move around within this setting. The unknown quality of the theoretical background driving the interactions has yet to be published.

In summary, there are a range of generic simulation development tools and specific projects in associated domains which can inform the task of providing training in behaviour management in teaching. Our task was to build upon these proposals and come up with something which would serve this purpose and be practical in use. Our response was to transfer a classroom initially built in Second Life to the OpenSim environment, and implement this on a single USB drive. We then added additional avatars representing programmed ‘bots which take the part of pupils in the virtual classroom.

Design Elements and Features

Creating an OpenSim USB[14] is simply a case of following the instructions at the Research: USB OpenSim page from the Tasmanian Polytechnic, or if you have an OpenSim USB already, you can copy all of the content

[9] http://livesim.sourceforge.net/
[10] http://edserver1.uow.edu.au/ClassSim/
[11] http://www.simschool.org/
[12] http://www.virtualprex.com/
[13] http://secondlife.com/
[14] http://vw-standards.wikispaces.com/Research+-+USB+OpenSim

to another USB to create a new one with the existing environment and objects on it. The OpenSim USB has been tested on Windows XP (32bit), Vista (32 bit), and Windows 7 (64 bit) operating systems. The software requirements for the virtual classroom are dependent on the user's needs: if you are only going to run the existing environment and edit the classroom, all of the software is contained on the USB and does not require installation on the computer. Running the executable program for the 'bots' will log them into the environment, and requires the installation of the OpenMetaverse library components. This is done the first time you run the program, and is simply a case of confirming that you allow the installation of the OpenMetaverse library. However editing of the code requires the installation of the full OpenMetaverse development library, Microsoft Visual Studio 2010, TortoiseSVN and the Microsoft .NET runtime environment. Exact instructions on how to configure each of these programs is available at the OpenMetaverse website[15].

Starting an OpenSim USB requires the running of three separate programs, each which must be running to be able to access the Virtual Environment (known as Localhost). To avoid a potential software conflict, exit any running copy of Skype, then execute the program \usb-opensim\mowes.exe. Once this is up and running, Apache and MySQL should be displayed as running as well. You then run \usb-opensim\diva-r13981\bin\OpenSim.exe. Next, find out if you are running a 32 or 64 bit operating system: check by right-clicking on 'My Computer' (or 'Computer' depending on your version of Windows) and selecting 'properties' followed by the system tab. If you are using a 32bit operating system, run OpenSim.exe; or for 64bit operating systems, run \usb-opensim\diva-r13981\bin\OpenSim32BitLauncher.exe. Once the corresponding OpenSim program has run and has ended at the point "Region <root> #" leave that program open and then run Imprudence.exe. All of these instructions are also in the ReadMe.pdf which comes on the USB in the root directory. The USB also contains some usefully pdf help guides in the \help\ folder and also includes simple video tutorials for using the Second Life-like environment in the \help\Video Tutorials\ folder.

Construction or editing of the classroom, or anything in the Second Life Environment, is done through the creation and altering of "Prims" which are just basic shapes (squares, tube, circle, triangle, pyramid, cone, etc). Most everyday objects can be created or manipulated by altering the size and position of these 'prims'.

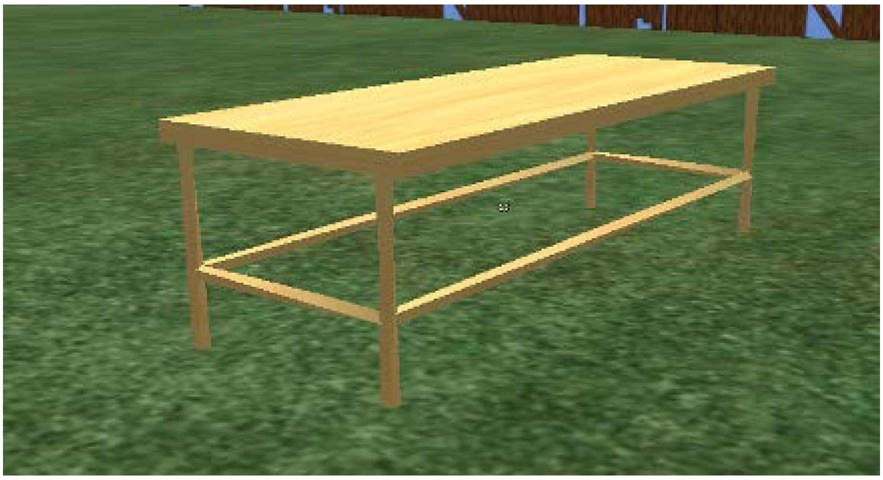

Figure 1: Example of a basic object created using prims

The basic table in Figure 1 is made up of nine Prims which are all cuboids re-sized and moved to make the tabletop (1), the legs (4), and the leg braces ¾ of the way down the leg (4). Once you have created an object, the prims can be linked together so the whole table is one "Object". That object can then be stored in the user's inventory and re-used multiple times. Extended to creating a classroom, the three dimensional veracity of the simulation can be quite accurate, and even the computers and interactive whiteboard in the current version have some limited functionality (see Figure 2).

[15] http://lib.openmetaverse.org/wiki/Getting_Started#How_to_compile_libopenmv

Figure 2: A fully rendered simulated classroom

The pupil bot avatars interact using the OpenMetaverse library of code developed to enable people to build remote controlled Avatars in second life. Using OpenMetaverse it is possible to create a C# program that when run, logs an avatar into the OpenSim USB environment (using the avatar's name and password) and then interacts with the users nearby. The code used is taken from the OpenMetaverse tutorial pages and was edited to suit the needs of the virtual classroom. The program basically takes the username and password given and logs onto that account and then interacts in the ways programmed. The two interaction methods built into the current prototype are reactions to specific words uttered in the public text chat dialogue, and the interactions from specific words said through the in-game instant message (IM) system.

Although the whole process described here relates to a single USB stick, these can be replicated very quickly using a suitable device such as those from NexCopy[16]. The advantage of this reticulation method is that pre-service teachers are able to use the 3D simulated environment and work through a series of behaviour management situations at their leisure using any available computer. The exercise does not require a high bandwidth internet connection free of firewall restrictions, and is therefore less demanding of resources. Also, there is no monitoring of failed attempts to control the class – and thus a more supportive environment to try other approaches to the challenges presented.

Procedures and Rationale

On entry to the OpenSim USB virtual world, the pre-service teacher is able to build and manipulate all of the objects in the classroom. The inventory of the Teacher avatar is kept empty but they can also log in with an Admin avatar and have access to all of the objects used to create the classroom. The preliminary goal of the Virtual Classroom Project was to create a prototype classroom that simulated the visuals of a real life classroom, and create a basic program that could remote control another avatar which would eventually represent an interactive responsive pupil bot. Once the program had been built to allow the bot to read the text comments of users around them, it was possible to link certain commands to actions that the bot performs. The finished prototype pupil will sit down on the command "sit"; stand at "stand"; jump at "jump" and stop jumping at "stop. Also, in this proof of concept phase, pupil bots will repeat phrases after the word "say" and log off the virtual environment at the phrase "goodbye".

Given pupil bots that can be interacted with, the possibilities of scripted conversation, movements around the classroom, etc. are limited only by the programmer's creativity. The next development of the virtual classroom was the expansion and rebuilding on the OpenSim USB to make it portable and thus easily accessible. This step removed the need for an internet connection, and at this point the realism of the classroom was stepped up a notch with the inclusion of miscellaneous objects and specific real world classroom components usually forgotten in virtual worlds (electrical sockets etc.). The next step in development will be the collection of real

[16] http://www.nexcopy.com/

world data and the programming of interactions and responses between the pre-service teacher controlled avatar "teacher" and the program controlled pupil. Our goal is to create an artificial intelligence that will respond to commands from the pre-service teacher based on a database of collected real world responses. A drawback of the prototype is its response to all instances when the trigger words are used in text chat. For example using the sentence "The quick brown fox will jump over the lazy dog" would cause the bot to jump (see Figure 3) even though that was not the intended purpose.

Figure 3: Example of pre-service teacher's avatar interacting with the pupil avatars

This issue is avoided by sending commands through the instant message (IM) system, but this restricts giving commands to each bot individually. It may be possible with a more advanced C# program to include a whole class IM function, or specific person public chat commands.

Discussion and Conclusion

Computer-based systems are used in much professional training to provide extended simulated experience. There are flight simulators for pilots, shipping simulators for naval bridge officers, life-sized computer operated mannequins for nursing students and haptic feedback for trainee surgeons. They have the advantage of providing repeatable training, where mistakes can be analysed and approached again with this insight. To a degree, these simulations can be scaled – made available to very large populations of trainees.

Few such computer-based simulations have been researched to determine their effectiveness imparting the expertise of behaviour management in teaching. This should include the design of each lesson, nature of each pupil, verbal and non-verbal communication – a whole host of socially demanding skills. 'Social Simentor?' and 'SimSchool' are two that focus upon related skills. Other funded projects are active in Second Life, which allows role plays involving geographically dispersed participants. This has a few major drawbacks since access to Second Life requires an excellent connection to the internet to create a viable realistic experience.

A locally hosted virtual environment on a portable USB Flash Drive avoids that problem, because there is no need for an internet connection at all. Our project is based on a virtual classroom built to be as close to a realistic classroom as is possible, developed within the OpenSim framework. Our current classroom is designed to simulate a high school computing classroom, but could easily be duplicated and rearranged to simulate any other subject space with memory capacity to spare. The most important feature of the virtual classroom is the ability to create virtual pupils, the end goal being the creation of artificially intelligent pupils that respond to commands from the teacher's avatar. Using voice recognition and speech to text we hope to make this become an aural/verbal interaction. Pre-service teachers can then try different behaviour management approaches in difficult simulations, to see the outcome of each approach.

Seven simulated scenarios are initially planned in the virtual practicum classroom (see Table 1). At the start of each session an avatar taking the role of the assistant principal will orally introduce the behaviour management policy and the individual pupils of the class.

Table 1: Planned initial scenarios and expected pre-service teacher behaviour management strategies.

Scenario	Expected behaviour management strategies
A range of classroom layouts will be provided.	Choose the layout which will minimise student interaction during circulation. (Dymoke & Harrison, 2008, p. 118)
‘Bot’ pupil behaviour (standing up, sitting down on their chairs) will be directly related to the volume of the pre-service teacher’s voice. This will be replicated into as many classrooms as necessary by putting the current pilot into a USB stick version of OpenSimulator.	Rule reminder: teaching routines (Rogers & McPherson, 2008)
Simulated students will be learning independently and the pre-service teacher will be able to interact by keyboard or voice with each one individually.	Encouragement and re-direction (Morgan, 2009)
Individual simulated students can be directed to undertake a specific learning activity and the pre-service teacher will be able to monitor compliance.	Direction
An individual simulated student (selected at random) will demonstrate off-task behaviour and if addressed in the required way will resume learning.	Scaffolding, proximity and rule reminder (Fields, 2005, p.12)
As #5 but a specific warning will need to be given before the ‘bot’ student resumes learning.	Support, warning, choice consequences.
As #6 but this time the ‘bot’ student will repeat the behaviour with a necessary escalated response from the pre-service teacher required.	Defiance responses, cool down chair (Charlesworth, 2008)
A small group of simulated students will undertake off-task behaviour and the pre-service teacher will need to use a variety of strategies to get them to resume learning.	All

If time and resources permit, the range of scenarios can be extended and link to specific aspects of behaviour management theory as advised by experts in the area. We will trial extensively with small groups of pre-service teachers (with ethical approval) and gradually extend this to include larger groups. Data will be collected through short surveys and focus groups to ascertain the perceived usefulness of the simulations.

As we proceed, we see a range of challenges before us. We seek a simulation which:

- is engaging and convincing
- has a theoretical background for artificial intelligence ‘engine’
- caters for ‘mob rules’ – balancing collective v. individual behaviours
- incorporates the affective domain
- is realistic
- includes audio interaction – speech recognition for input and text to speech for output
- is replicable – the same interactions generate the same responses
- contains a series of escalating behaviour management scenarios

To succeed we will need to build upon established artificial intelligence principles. Much artificial intelligence behaviour appears to be database driven, or to derive from exploration of possible system states (e.g. game move variations) for a target pattern. In one possible model "the belief network model updates the stochastic / fuzzy belief assigned to the facts embedded in the network until a condition of equilibrium is reached, following which there would be no more change in beliefs” (Rios, 2010). Other tools that could be deployed include fuzzy Petri nets, for handling both imprecision of data and uncertainty of knowledge by a unified approach. Looking at the other simulations mentioned previously, we believe our front end and user interface are highly attractive and becoming extremely useful. The challenge ahead will be to couple this aspect with theory-driven functionality such as that in simSchool, and engaging these artificial intelligence techniques to overcome the challenges we have identified.

The program is very much in its infancy, with only the ability to react to basic text-based instructions (sit = the pupil sits; goodbye = the pupil logs off) but with a specialist in C# the coding of a fully interactive experience is easily possible. OpenSim works almost identically to Second Life, building, interacting, 3D modelling, and we are expecting to incorporate audio-based input and output shortly. The babble of virtual pupil's voices will be quelled by a gentle instruction from a well-trained pre-service teacher!

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