

5.2 A Storm's Approach; Hurricane Shelter Training in a Digital Age

A Storm's Approach: Hurricane Shelter Training in a Digital Age

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Abstract: New York City's Office of Emergency Management (OEM) originally ran hundreds of classroom based courses, where they brought together civil servants to learn how to run a Hurricane Shelter (HS). This approach was found to be costly, time consuming and lacked any sense of an impending disaster and need for emergency response.

In partnership with the City of New York University School of Professional Studies, Gronstedt Group and Daden Limited, the OEM wanted to create a simulation that overcame these issues, providing users with a more immersive and realistic approach at a lower cost. The HS simulation was built in the virtual world Second Life (SL). Virtual worlds are a genre of online communities that often take the form of a computer-based simulated environments, through which users can interact with one another and use or create objects. Using this technology allowed managers to apply their knowledge in both classroom and remote learning environments. The shelter simulation is operational 24/7, guiding users through a 4 ½ hour narrative from start to finish.

This paper will describe the rationale for the project, the technical approach taken – particularly the use of a web based authoring tool to create and manage the immersive simulation, and the results from operational use.

1.0 INTRODUCTION.

The New York City Hurricane Shelter Simulation is a 3D immersive Hurricane Shelter training course developed in Second Life. The environment was modelled on a real School building in Brooklyn civil servants across the country have been using this simulation to up-skill on how to open, operate and close a hurricane center in an emergency situation. During this 4 ½ hour simulation users are guided through a structured narrative around the anticipated approach of a Hurricane Leo. Users work in groups through a total of 62 exercises created using PIVOTE (PIVOTE is an open-source authoring system for learning in virtual worlds, created by Daden Limited).

The PIVOTE system controls all the exercise logic and is and managed using several simple web interfaces.

The project earned a second place award in the AI (Artificial Intelligence) Assisted Training category of the Federal Virtual Worlds Challenge from a pool of about four dozen entries. The purpose of this paper is to identify the reasoning behind using innovative technologies such as Virtual Worlds; we intend to describe the following and achieve an in-depth analysis of our findings;

- Investigate the reasoning behind using a simulation technology rather than traditional education methods.
- What PIVOTE is and how it assisted in the development and scalability of the project.
- How the project has been utilized and tested to date by NYC civil servants.
- The future roadmap of the project, including duplication and roll out.

- And present our findings and observations of learners using this innovative technology.

Our approach to training presents further research opportunities that are worth exploring as the project develops in the future.

2.0 BACKGROUND CONTEXT.

In 2007 CUNY SPS started the coastal storm training project, with the intention to train 32,000 staff / city workers. The largest group, with the greatest training requirements was found to be Hurricane Shelter Managers.

New York City hurricane shelter managers, numbering over 2,000, were required to take a full day of traditional instructor-led class-room training. While feedback from the class room sessions was positive, many participants stated that they wanted more hands on work in the facilities with the equipment and the situations that they would likely encounter in a large scale sheltering response. In response to this feedback, New York City Office of Emergency Management has successfully run live hurricane exercises at facilities designated as emergency shelters both in 2006 and 2008. However, the logistical and cost requirements of training 2,000 managers this way does not make it a scalable option. Instead, they opted to develop an immersive 3D program.

The four-hour-long learning simulation takes place in a virtual hurricane shelter developed in Second Life that is modeled on a real school building in Brooklyn. The learner is playing the role of a Hurricane Shelter Manager - opening, running, and closing the shelter. This 3D virtual rehearsal and training simulation helps City employees practice their shelter management skills and apply problem-solving skills in a realistic environment. They can take the self-paced simulation on their own or in a small team of three to five players. "Our feedback suggests that the cooperative experience of playing and being scored as a small group is more effective than a single-player experience," says Andrew Boyarsky, Project Director at the School of Professional Studies, CUNY

Graduate Center, who spearheaded the program.

3.0 OVERVIEW OF THE SIMULATION.

The simulation starts with a newscast announcing that "Hurricane Leo" is forecasted to hit the New York City area in a few days and Hurricane Shelters are being activated. The learner has just arrived at the shelter from the Evacuation Center. They practice setting up the facility for shelter clients when they arrive, designate key shelter areas, assign staff, and ensure that areas are set up and supplied properly so the shelter is ready to open to the public. When the shelter clients arrive, learners are challenged to solve a number of thorny problems. How do they resolve conflicts? How do they communicate with guests who don't speak English? The AI recognizes key words and determines the next response by the non-player character. The complete simulation includes 40-50 such non-player characters driven by the AI system. Individual scores are captured in the PIVOTE web-based authoring system.

As the clock ticks down to zero hours, learners prepare for the arrival of the storm. After the storm, they conduct a walk-through to check that the building is safe, and address post storm concerns of the shelter clients and the needs of the facility. For some issues they will find solutions in a Field Guide while others will require some thought using managerial skills and experience. Learners need to think on their feet, just like in the real world. People learn in context, while earning points, solving problems and receiving feedback.

3.1 What is PIVOTE and why use it?

Before PIVOTE the standard way of creating learning exercises in the Second Life virtual world was to embed scripts written in Linden Scripting Language in the in-world objects. Text was either embedded in the scripts, or placed in "notecards" which were also embedded in the objects. This approach required a relatively high technical skill level, made maintenance a nightmare since to change a piece of text or behaviour you had to locate the relevant

object in-world and make the change, and meant that the whole exercise was bespoke to Second Life.

In developing a paramedic training system for St George's Hospital [1], London Daden were introduced to Medbiquitous Virtual Patient (MVP) [2], an XML (Extensible Markup Language) standard created to enable medical schools across the globe to share "virtual patients" - simple training exercises for medical professionals based around a medical case and usually following a "branching" or "string-of-pearls" structure [3]. It was realised that the MVP standard could also be used to define a virtual world training exercise, allowing the exercise to be defined and maintained in MVP XML through a readily accessible and manageable web interface, but with the user experiencing the exercise within the virtual world by interacting with in-world objects and people. With this approach the scripts in world could be kept far more generic – and effectively just passed an object ID and a user action (e.g. chest – touched) back to the MVP "player" to work out the relevant response and pass that information back in-world. In this way all structure, logic and non-3D content of the exercise was kept in a manageable form on the web as MVP XML, and the bespoke in-world content was kept to a minimum. Added advantages of this approach was that every student action was automatically detected and could be easily time stamped logged, and the exercise could potentially be played from an environment other than the virtual world – such as the web.

The new MVP based system was called PIVOTE [4]. The MVP player, which manages the student interaction during an exercise, is written as a web-service. This allows any client environment to be potentially used as a PIVOTE front-end, from HTML (Hyper Text Markup Language) and Flash to mobiles.

There are several key reasons why a PIVOTE-based approach makes sense for virtual world exercise development:

- **Maintenance and scalability:** The exercises are created online rather

than in-world, making it easy to maintain and alter content without any SL or scripting expertise needed. The system is extremely robust and can be used by non technical members to create new exercises relatively quickly and with minimal technical input. The system is also multi-user allowing many people to play through the same exercise at any one time (of course the maximum number is dependent on land capacity of the virtual world technology).

- **Platform neutrality:** Since all the structure and non-3D content of the exercise is stored on the web the solution is independent of SL; meaning; the exercise will not be tied to this particular platform if they wished to port their exercises to another technology for any reason. These may include mobile technologies, flash, or any other virtual world.
- **Accessibility:** PIVOTE provides a platform where if learners do not have access to a Second Life capable PC they can still participate in the scenarios via a simple web interface.
- **Reporting:** PIVOTE records all interactions that take place in world between objects and learner for analysis online at a later date, including time-stamping of every participant interaction with the system, and allows export of this data for later analysis.

By implementing a PIVOTE based solution for this project:

- We can use the code already in PIVOTE to track participant activity without having to create a bespoke solution for this project at additional cost.
- We can use the object and animation control software already in PIVOTE to implement and manage the majority of the exercise – again without having to write new code and again saving cost.
- We can use the HUD (Heads up display) management used on past PIVOTE exercises – again without

having to write new code and again saving cost.

- The structure of the exercise will be more clearly visible and changeable through the web – rather than spread through multiple scripts in multiple objects, reducing on-going support costs.
- All of the non-3D content can be managed and edited through the web – allowing rapid implementation of simple text changes.
- Participants can be given access to a text-based version of the exercises.

4.0 SIMULATION COMPONENTS & GAMIFICATION.

There are flaws in the way we use traditional education techniques, users lack engagement and are demotivated by having to take part in assessments. When a learner for example is being formally assessed through a standardized test or similar device they instantly become anxious to do well and alter their behavior; this can sometimes have an effect on the outcome. This reaction is referred to in human behavioral science as the Hawthorne effect, when those who are being observed react to the knowledge that they are being observed [5].

With the HS Simulation project we wanted to employ these new techniques and avoid some of the traditional pit-falls. The project was designed to be fun, engaging, realistic, collaborative and most importantly educational. By using a technology like Second Life we opted to use a number of Gamification techniques throughout the simulation trainer. “Gamification can be explained as the process of game thinking and use of game mechanics to engage audiences and solve problems.” [6] For this project the important thing we aimed to achieve was “Gamifying” the practical hands on experience learners would have in a real emergency situation, making the training more exciting and re-engaging than with traditional methods.

Using and applying a number of gamification techniques we aimed to encourage the learners through the methodology - “progress encourages

progress”. To do this the user is presented with clear, tangible objectives in the form of exercises and modules which give a sense of flow. We believe the human desire for efficiency and to do well acts as a powerful motivator here as the users gain instant feedback on their decisions. This is supported by the sense that the user is embodied in the Role of the Hurricane Shelter Manager and is not simply being tested for it.

These were achieved by using a number of key components inspired by commercial game based techniques. In the following section we will describe these components and define why they strengthen the learning experience throughout the training simulation.

4.1 School and Environment.



Image 1 The school building

The school and Environment were modeled on a real school building and surrounding area in Brooklyn, as shown in image 1. Providing a backdrop and content for the learner to relate to. Many schools and public buildings across America are deemed Emergency Centers in case of an emergency and by providing such an environment for this simulation it provided a sense of realism and grounding.

4.2 Narrative and Video.

Throughout the simulation the story of Hurricane Leo is told; the storm is reported from a variety of characters; including an instructor, shelter clients and most importantly a fictional news report. This is given at the beginning of each module and in the form of reward for completing the previous module.

The news reports provide a sense of participation in the event, conveying both

what is happening and providing a sense of context and urgency.

The news reporter uses a number of graphical aids (weather charts / simulations of Hurricane trajectory) and fabricated interviews with specialists, with the solo purpose of immersing the learner in the story and current situation.

4.3 Characters.

There are four types of characters (primatars) found throughout the simulation, characters in the exercises, which are interactive and talk to the user during the course. HS staff and police are found throughout the simulation, these represent the staff and security that would actually be present during the use of the Hurricane Shelter. And finally shelter clients, these add a sense of realism and busyness around the shelter. Shelter clients also make statements in the chat channel as you walk past them. Example statements include -

[05:21] Shelter client: I hope my snake is OK...

[05:22] Shelter client: My cot is surprisingly comfortable...

Again by employing this simple technique it adds to the learners "sense of realism" and adds to the overall narrative.

4.4 Animations.



Image 2 An example animation

Animations are found throughout the simulation – these are specific animations triggered when the user accomplishes an exercise. They see the result of their action played out in the 3D world. These animations are developed in-world and triggered via PIVOTE, an example of an animation can be seen in image 2. After the learner has answered a question regarding

unpacking supplies; staff form a daisy chain to bring the supplies into the building.

4.5 Exercises.

An available exercise is identified by the red question mark above the point of interaction. To continue and begin the exercise a user needs to click the question mark. This system is traditionally seen in more commercial games, for instance in World of Warcraft, available quests are indicated by different symbols.

In the simulation a question mark has three states, red for available exercise; amber for exercise in progress and green for exercise complete. This helped indicate to the user at which stage they are in an exercise and their progress. We found this gave users a sense of satisfaction and achievement by providing visual feedback and encouragement as they progressed. It also helped to reassure them they were using the system correctly.

For ease of use the exercises throughout the simulation follow a particular rule; PIVOTE was programmed to display the following sequences of text, when a user enters and exits an exercise, we found this format was preferred by the test groups; The only disadvantage to this system was the dependency on local and server side lag, which may cause the text to display out of sequence. Image 3 shows an example of the conversation sequencing.

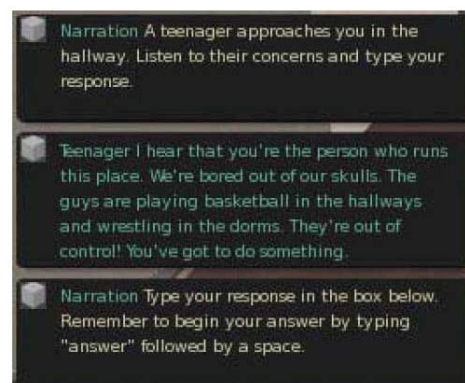


Image 3 Example conversation

4.5.1 Starting an exercise

1. **Description HUD text:** i.e. "A teenager approaches you in the..." (Yellow text).

2. **Primatar dialogue:** i.e. "Teenager I hear that you're the person who runs this place.." (green text).
3. **Primatar audio transcript** (associated with primatar)
4. **Narration HUD instructions:** i.e. "Type your response in the box below..." (Yellow text).

4.5.2 Ending an exercise

1. **Primatar dialogue:** i.e. "Teenager That is sooooo cool! I'll..." (Green text).
2. **Final audio transcript** (associated with primatar)
3. **Narration HUD feedback** i.e. "You should have found some places..." (Yellow text).
4. **Narration HUD instructions** i.e. "You've completed this activity. You have <number> more to go to complete this assignment. Follow the arrows to the next activity and then click on the red question mark." (Yellow text).

4.6 The Narration HUD.

The HUD is the learner interface for the simulation, it lists their score and allows them to access help resources. Two important aspects the score and the storm count down, both of which provide the learner with instant feedback on their progress through the simulation.

4.7 Navigation.

Arrows are located throughout the HS simulation to show the user where they need to go next. The arrows are only displayed once an activity is completed, connecting and displaying a path between exercises. This addition was added after the initial user tests; the school building was found to be too large and learners found it hard to navigate around the course without getting lost or taking much longer to find the exercises. This visual assistance has to be extremely helpful allowing learners to move seamlessly between exercises without delay.

Again the arrow system also reinforces the learner's sense of achievement, unlocking the next path as they progress, from exercise to exercise.

4.8 Storm system.

The storm system is made up of a number of components. The Hurricane, The Rain system, Sensor system, Hurricane Audio, and random rubbish blowing in the wind.

Together these elements provide a sense that a Hurricane is approaching. These components are controlled using PIVOTE and based on the user's behavior in world. The storm begins as the learner is instructed to head to the command center; when entering the building a sensor is triggered and storm begins.

5.0 USER EXPERIENCE.

The course was rolled out at the start of 2011 with an early Beta test of 7 sessions. A total of 14 participants took part in the course with an average of 2.14 participants per session. With over 93% responding to a course evaluation, the following quantitative results were tabulated on a five point (Liker) scale 5-strongly agree, 4-agree, 3-neutral, 2-Disagree, and 1 Strongly Disagree. The results were as follows:

Rating Area	% Indicating they Strongly Agree or Agree with the Statement
Did the program make you more confident in participating in the coastal storm plan sheltering system	86%
Did the program include training activities that were effective	86%
Did the program provide training in Hurricane Shelter activities that were closer to real world activities than classroom based courses.	100%
Did the program engage you as a learner	100%

Table 1. Evaluation results.

The first two ratings above are comparable to other types of online courses in the

curricula. However, the second two ratings are significantly higher than those for other online course formats. Comparing the last rating for engagement, at 100% vs 87% for a 1.5 hour flash based course with similar content, this is a difference of 13 percentage points. Indeed, when informally polled at the end of the course whether they would take the course again if given the chance, an overwhelming majority agreed they would.

These evaluations also capture open ended comments and the feedback is largely positive. Some of the most frequent comments from participants:

- The course was interactive.
- Provided more hands on work where and with what you would be dealing.
- More real life, allowing visualization

Experienced shelter managers and emergency responders have given the simulation high acclaim, expressing how great it is to have activities in a realistic environment, providing an experience as close to the high fidelity of a real life exercise.

In fact, the course administrators have observed that with groups of 3-5 course participants they quickly form a team with one person assuming the role, without prompting or direction, of shelter manager with the others taking direction. This team formation facilitates social learning between peers as one participant will refer to directions from the embedded field guide that should be followed. Further to this point, we have observed a greater sense of team cohesion. One participant was observed telling a caller on his cell phone that he needed to get back a team exercise and would call later on a break, the first time something like this was witnessed in overall shelter training program. These aspects are not as present in both classroom or in individual 2D (flash based courses).

Often at the start of sessions, it was observed that participants will remark that they do not engage with these types of technology. Typical participant comments are along the lines of “my kids play these types of games”. Or “That is not for me”. When they start off they are often

psychologically “on the fence”, and within an hour they appear to have psychologically “stepped off the fence” and are fully engaged. By the end of the simulation when the project director has entered the room to tell them the course is close to over participants commonly do not notice he is in the room they are so engrossed and hardly realize that four hours have passed!

6.0 DISCUSSION.

CUNY SPS in partnership with the NYC Office of Emergency Management is looking to expand the use of the simulation in a couple of ways. The course will be replicated on three additional islands (server spaces that can host an independent instance) in Second Life. While this allows for a greater number to partake in the simulation (4 islands x 5= 20 per session), it will also allow the simulation to be used in a larger exercise with multiple facilities; a cluster of hurricane shelters will be managed by an evacuation centre, allowing NYC OEM to test command and control within the hierarchy.

Within NYC, many City agencies use City schools (Dept. of Education) for emergency response plans, e.g. Points of Dispensing (PODs) for mass vaccinations, commodity distribution post emergency (C-PODs). NYC OEM is considering adding minor enhancements and to coordinate the use of the simulation for these multiple plans as it reduces the expense of holding exercises and allows for the immersive training that has been previously described.

NYC OEM is also part of the Regional Catastrophic Planning Team that coordinates emergency preparedness planning and response for catastrophic disasters. This includes four states and 30 counties in the New York/New Jersey metro area, 22 million people or 1/14 US Citizens. NYC OEM is considering expanding the use of this platform for emergency shelter training and exercises for multiple levels for its regional partners. This simulation could possibly be targeted to a potential regional audience of 150,000 shelter staff.

CUNY SPS would like to evaluate the effectiveness of this medium for both training and exercises in contrast to those in both classroom and 2D (flash based) courses by assessing different cohorts with similar characteristics in actual emergency shelter deployments.

6.1 PIVOTE.

In looking at how to move PIVOTE forward in the future we have focused on two areas – the ease of use of the exercise authoring tool, and extending PIVOTE to control the layout of the 3D space as well as the logic and content of the exercise. In both of these we have been informed by some of the prior work within the field of eDrama by an organisation called Hi8us.

The design of the authoring screens in PIVOTE reflect the data hierarchy in MVP - Activity Nodes , Availability Nodes, Asset Nodes. Whilst this architecture gives significant potential flexibility it is not something we have ever needed in practice and currently serves only to confuse the author. MVP was also a very “link” based approach – nodes automatically lead to other nodes, whereas a virtual world environment is more “real” - student choices are what determines what node follows each node. What we have found is that clients and authors are far more comfortable with the eDrama terms of “prop” and “actor” (an actor being a non-player-character in the scene). The new version of PIVOTE will use a props and actor metaphors, with each prop 9 and actor) having a set of associated behaviours based on the possible student actions. We think that this will make the system not only more usable, but also significantly enhance re-use of objects between exercises.

Whilst PIVOTE abstracts the logic and non-3D content of an exercise into XML on the web, it still needs a 3D specialist to create the 3D environment. Having moved to an eDrama approach it makes sense to bring the positioning of props and actors into PIVOTE. The intention is that the author is presented with a set of libraries for different scene types (e.g. city emergency, rural

emergency, hospital, industrial site etc) and uses a 2D web-based drag and drop environment to create the scene (including elements like floors/roads, building walls and even terrain backdrops). Then either through the layout interface or a simple prop list the allowable actions and behaviours of each prop and actor can be defined – even specifying routes for actors and mobile props. Once the scene is complete – and tested on the web – the user can then save it, and issue the command to have it instantiated (called “rezzing”) in the virtual world.

The next generation of the PIVOTE system is currently in development – called OPAL – in conjunction with a UK Academy School – with the aim of making it usable by teachers and students as well as by training professionals.

7.0 CONCLUSION.

The driving force for using a virtual world platform such as Second Life was to provide a hands on experience for assigned emergency shelter managers in the working environment (a City school as an emergency shelter) performing the activities using the equipment and other materials that would be available during an emergency sheltering response. This need emanated from previous training season feedback by assigned shelter managers. The emergency shelter managers assigned are mostly City school facility managers, and, while they are familiar with the building they work in and their normal operations, they are not familiar with the operation of an emergency shelter. Until the release of the Hurricane Shelter Simulation the training available for shelter managers has largely been classroom based and comprised of table top exercises that incorporate various multimedia to help simulate the environment. Unfortunately, as well designed as the classroom exercises are, they fall short of providing the level of fidelity of the simulation.

The simulation provides a sense of self-relevance and context for the learner through the use of the fictional news reports, game aspects, and audio and chat input. Prompting the learner to move about the facility, to undertake the various tasks

and problem solving, gives the individual and team a sense of responsibility and ownership that is not available in both a classroom and 2D (e.g. flash based) courses.

This approach to online, simulation based training suggests that the gap between training / role-playing in the classroom can be bridged with the use of technology. As the project develops we aim to continue a comparative study of the costs involved for development and our original findings of the live hurricane exercises run during 2006 and 2008. Indication already suggests that scalability makes a simulated approach more cost effective compared to traditional classroom based training.

Using a technology of this type isn't without its challenges and limitations; One consistent observation is the mind-set of the learner and their apprehension to use such an innovative platform. Even though during our trials users quickly overcome these apprehensions in groups. It is imperative that we consistently consider the typically "less technical" user demographic during our development, and ensure we make every concession needed to make the HS Simulation easy to use.

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