Occupational Medicine Simulation Project

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In 2013 the Occupational and Aviation Medicine (OAM) unit of the University of Otago secured a project grant to develop a simulated virtual world environment for students of this unit, specifically those studying occupational medicine as distance learners. The simulation would be employed by facilitated student groups to contextualize occupational data for specific work processes, to re-enact occupational health examinations in the compiling of clinical assessments and to develop a research proposal for assessing health outcomes in these hazard environments. Developmentally, the underlying intent of the project was twofold; firstly, to investigate the virtual elements essential to the creation of an authentic context for learning and secondly, to explore those virtual aspects that might provide a supportive learning environment for the geographically dispersed student body. This paper details the pedagogical and design rationale employed by the author in the pursuit of this intent.

Keywords: Virtual, simulation, occupational medicine, contextual learning, authenticity, presence.

Project Overview

The project brief from the Occupational and Aviation Medicine (OAM) unit was to create a virtual environment representative of areas of the cement manufacturing process, based on quarries and cement factories in the United Arab Emirates. Work processes are an integral part of occupational medicine's week-long residential school, where group discussions around the occupational hazards in a particular environment, the compilation of workers' occupational health histories and the role-playing of clinical assessments, all form part of an overall exercise in the development of a research proposal for assessing health outcomes in a particular hazard environment. Limited to one residential school per year due to the students' geographical distribution, the project proposes to address this limitation by providing opportunities to engage in these exercises remotely.

The open source server platform OpenSimulator was chosen as the test bed for the simulation build, its cost-effectiveness, agile development capability and scalability all components in the selection. The open source virtual world viewer Firestorm enables users to enter this environment as a customisable avatar and engage with both the virtual environment and each other; the former through touch and menu options, the latter through text and voice chat. The build itself would involve two main features; the manufacturing process areas and the clinic where the assessment of workers would take place. The process areas would be presented as identifiable immersive spaces, allowing participants to experience the occupational data in the context of the actual work environment from which it was gathered. While the simulation cannot represent all the occupational hazards, heat or vibration for example, the essence of these might still be experienced through viewing the data in association with the environment. As Heerington, Reeves and Oliver (2007, p.85) state "the physical reality of the learning situation is of less importance than the characteristics of the task design and the engagement of students in the learning environment." In a similar manner the clinic would provide an immersive environment conducive to the task at hand, the occupational health assessment of workers, providing that "strong sense of situation" (Falconer, 2013, p.298) essential to an authentic experience. The clinic would enable students to perform different medical examinations and order a number of medical tests, effectively progressing through all the tasks related to an occupational health consultation. The worker would be role-played by a facilitating staff member, enabling students to also practice the communication skills necessary for effective patient examination.

The Pedagogical Foundation

As a general approach, the use of virtual environments for health and medicine education has been well documented (Creutzfeldt *et al*., 2010, Danforth *et al*., 2009, Loke, Blyth and Swan, 2012, Wiecha *et al*., 2010) and acknowledges the benefits of using these environments for simulated medical practice. These studies also give credence to the immersive aspects of virtual environments as enabling situated learning, Loke, Blyth and Swan (2012, p.570) stating that students were able to “to call the shots and to live through the consequences of their decisions” in the simulated environment, constructing knowledge throughout the experience, rather than just responding to lineal, paper-based case studies. The use of well-executed virtual world simulations has also been evidenced to provide highly experiential learning spaces (Nygaard, Courtney and Leigh, 2012, Feinstein, Mann and Corsun, 2002) with an authenticity of learning experience that, significantly in the author’s view, is not necessarily bound to the physical fidelity of the simulation, but more related to the cognitive fidelity of the tasks provided (Heerington, Reeves and Oliver, 2007).

In the context of the application virtual environments are also being investigated as a means of enabling social presence and co-presence for a student body that is highly dispersed geographically; aspects shown to provide both an enhanced sense of community and increased satisfaction for learners (Bulu, 2012, Edirisingha *et al.*, 2009). Research suggests that virtual worlds do possess this capability, enabling a sense of being together and providing a possible means to negate the isolation and loneliness often experienced by distance learners (Hassel et al., 2012, Johnson, and Levine, 2008). Additionally, the provision of an educational space that offers an immersive experience predicated in context, would, through authentic learning, support an improved student performance (Chapman and Stone, 2010).

The Simulation

The Simulation Orientation Area

The orientation area is the space first encountered when students log into the simulation. Its purpose can be likened to a halfway point between the physical world and the task-based environments, where students are introduced to the mechanics of moving, seeing, communicating, costuming their avatar and interacting with each other and the simulation. It also contains the introductory materials that relate to the course objectives and breakout areas for class discussions and round-ups. Visually it sets the scene, introduces users to the simulation’s conventions of use and readies them for engaging with the environments to come.

Figure 1: Orientation Area/Process Area Environment (Quarry)

The Process Area Environments

For this trial project the worker selected for the clinical assessment was to be a 52 year old, male, heavy vehicle driver who, for the past 30 years, has been transporting rock from the quarry to the cement plant’s primary crusher. These areas therefore would be the required process areas necessary for an overview of this worker’s occupational environment. Operationally, occupational medicine clinicians do not normally access these environments; rather they assess health outcomes based upon field measurements taken by other agencies and consider these alongside the occupational history and clinical assessment of the worker. Situating the students in the simulated work environment was not then a necessity for the collection of data but more about giving consideration to the idea that information provided in an authentic context supports the integration of theory into practice (Falconer, 2013). From a cognitive task perspective, this method offered opportunity for more robust group discussions around aspects such as data accuracy as opposed to just being presented with a data sheet as a fait accompli, encouraging higher levels of engagement and supporting the possibility of emergent learning behaviour in the participating student group (Kays and Sims, 2006).

In the process areas' development a limited budget did not allow for the creation of high fidelity models, nor were they deemed necessary from an immersive perspective. Other affordances of the virtual world were available; the perception of space, size and distance; atmospheric factors such as dust and noise; each adding to the immersive quality of the environment and supporting a sense of being there. Additionally, Gustafson (2001) considers that the meanings we give to a place are more often not just about our relationship with the environment, but an amalgamation of the relationship between one's self, other occupants of the place and/or the environment. This concept was given consideration by not only providing environments that spoke to the participants as places relevant to their learning; occupational spaces; but by providing the ability to dress for those spaces appropriately, bringing authenticity to one's own presence in the simulation and visual reinforcement through the presence of others, dressed for their roles. The locker room enabled this capability.

The Locker Room

Evidence suggests that the success of learning activities conducted in virtual world environments has a correlation to the degree of embodiment and presence students have been able to form (Peachy and Childs, 2011) and that identity and embodied presence are interconnected (Mennecke *et al*., 2011). Ganesh *et al*'s (2012) work on self-identification with virtual agents points to the representation of self from a third person perspective as a facilitating factor in appropriating the avatar to the user's self-identity, while other works additionally point to the importance of appearance for the construction of identity in virtual worlds (Martey and Consalvo, 2011, Neustaedter and Fedorovskaya, 2009). In light of this research, supporting presence through the creation of identity was considered an essential factor in enhancing not only the immersive experience but the learning experience as well. In this simulation however, appearance, i.e. dressing for the part, is not just tied to identity creation but is a cognitive task in itself, as appropriate outfitting in the required protective clothing for each process area environment, based on the hazard data for those areas, provided another aspect of situational context and learning.

What the locker room then provided, over and above its usability intent, was an environment for the observation of self, where preparing for the role was the focus. This focus might be likened to a dressing room, the participants as actors in that preparatory stage for a play they are about to perform. Goffman (1956), in his consideration of self, talks of the performer's belief in the part they are playing and how their impression of the reality of their performance influences in turn their audience's; others; impression of reality. This creation of self as an in-world identity, appropriately dressed for a chosen process area environment would, in the author's view, enhance that impression of reality and support that belief, or rather the suspension of disbelief, enhancing not only one's own sense of presence and immersion in the virtual space but the sense of presence and immersion of the other participants; the audience.

The Medical Assessment Clinic

The clinic focuses on providing an environmental authenticity to the clinical assessment of the worker, with locker room costuming enabling students to assume an identity to support this authenticity, i.e. through the provision of theatre greens. Realistic simulations of the assessment tasks have not been developed, rather the students may choose from a varied number of physical examinations and medical tests, provided as selectable choices through a heads-up-display (HUD) and associated menu options, to assess the worker. This approach considered that there is no real educational benefit in constructing the physicality of taking, for example, the pulse and accruing the associated development cost. Rather the students just click on the take pulse button and the HUD responds with a programmed pulse rate response; in this manner the pulse taking has been acted out. This is a reiteration of the "cognitive realism" of tasks being of greater importance than the creation of realistic simulations of the events (Heerington, Reeves and Oliver, 2007).

The Heads-Up-Display (HUD)

The HUD, mentioned above, also provides a consistent aspect across all areas of the simulation. It facilitates movement to all areas and costume assembly in the locker room and offers multiple forms of engagement with the process area environments through the presentation of hazard data, graphical depiction of specific hazards, hazard exposure calculators, etc., encouraging the possibility of learner-centric experiences (de Freitas and Nuemann, 2009) and active engagement, inside and outside of facilitated class activities.

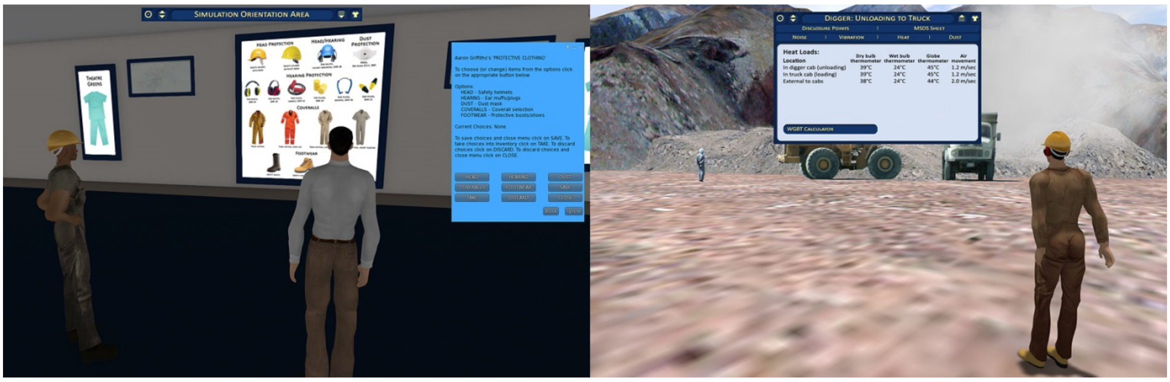

Figure 2: Locker Room/Accessing Hazard Data and Calculators

Final Reflections

Though yet to be provided with test students, there has been evidence, in the consultative demonstrations conducted, that this project will achieve its aims. It delivers an engaging, authentic and immersive experience, providing opportunities for situated, experiential and collaborative learning for the student community. It encourages a learner-centric cognitive approach with the tutor's role as a facilitator of that process. A concluding statement from Heerington, Reeves and Oliver, (2007, p.94) seems appropriate; "When appropriate technologies can be selected as required and used as cognitive tools to solve complex problems, the responsibility for learning moves back to the learner, rather than the designer of the virtual environment."

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