INNOVATIVE ONLINE TRAINING FRAMEWORK SUPPORTING IMMERSIVE SCENARIO-BASED SIMULATION FOR CLINICAL DECISION MAKING AND LARGE HEALTHCARE COMMUNITY OF PRACTICE

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ABSTRACT

There is reasonable doubt that current arrangements for clinical training will sustain projected increased requirements for health education. It is evident that Simulation Education provides a solution to this sustainability problem, and the increasing sophistication of Virtual world technologies create opportunities to migrate elements from traditional to online models, thus addressing the issues of cost of access to traditional Simulation Centres. However, creating exciting online environments in isolation is insufficient in addressing the complex requirements of undergraduate health care training.

The authors propose that by balancing the focus between cognitive reasoning structure and the need to establish an emotional connection, they have delivered a high quality, learner-centric online world that increases the "real world readiness" for undergraduates. Furthermore, by delivering the tool through a supportive online community of practice, the learner has a sustainable, continuous opportunity to practice essential skills in a safe environment before entering the clinical environment.

Keywords: healthcare simulation education, virtual simulation, community of practice

1. INTRODUCTION

The traditional approach to healthcare education relies on patients as the primary vehicle for clinician training. Aside from the ethical issues of patient safety and well-being, practice on live patients is opportunistic and does not allow repeated practice to achieve competence.

Furthermore the rapid growth in the number of trainees combined with a focus on increased efficiency of the healthcare system mean that the current system will not be able to sustain the projected clinical placement requirements for health education.

Simulation Based Education (SBE), using mannequins and part-task trainers, provides a solution partial solution to this sustainability problem, but access to SBE is limited by geographical isolation and cost.

Online 'push' based tools may augment traditional and SBE learning platforms, however the growing sophistication of virtual world technologies create further opportunities to enhance the learning provided by online models.

There is no resource base that allows professionals at different levels of learning, from different geographic locations and different craft groups to collaborate openly. Importantly, there is no forum for these groups of professionals to shape their own learning and teaching resources and link their day-to-day world with their world of learning, specifically the multi-disciplinary nature of their world.

These issues were highlighted by the Productivity Commissions in their research report [2005] which noted the poor coordination between education and training and the health delivery aspects of the system and the low responsiveness to changing needs.

To address this situation, the Australian Federal Government has established the Health Workforce Australia (HWA) to help understand the challenges and to implement a robust system of providing a skilled, flexible and innovative health workforce that meets the needs of the Australian community. The use of simulated learning environments is one of the strategies acknowledged by HWA as assisting to meet the training requirements.

This focus from Federal government has enabled a project to focus on communities of practice in the Simulation Education community. Additional support from the Victorian state government enabled the creation of a Virtual environment for nurse training. The main project collaborators have been able to blend aspects of both these projects to create an Innovative online training framework supporting immersive scenario-based simulation for clinical decision making as well as large healthcare communities of practice.

2. SUSTAINABLE CLINICAL PLACEMENTS

The Productivity Commission report of 2005 projected the need for an additional 1.3million clinical placement days by the 2013 academic year. The present system of

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health workforce training and deployment cannot meet the growing need for health services either locally or globally. Chronic disease and an aging population are placing escalating demands on resources; additionally there is a compounding challenge of the health workforce itself aging.

In order to cope with this additional demand for training, more innovative education methods are needed to supplement the traditional classroom and hospital learning environments. With significant increases in interest in virtual learning environments there is huge potential for online immersive simulation education.

3. OPPORTUNITIES CREATED BY ADVANCES IN TECHNOLOGY

A number of developments over the last decade have allowed physical simulation education to be moved to a completely virtual world. The exponential growth of computer processing power over time, famously predicted by Moore in 1965, has been consistently occurring for over 40 years. This dramatic increase in processing power underpins the specific developments required to provide an effective virtual medical simulation. Graphics rendering has improved immensely over the last decade, allowing for interaction with very high fidelity 3D visual representations of real geographical locations. Although 'ground up' software development costs have been, and can still be, prohibitively expensive, the use of already existent graphical engines has made this technology more economical and transferrable to an almost limitless array of educational requirements.

The concurrent growth of data transmission infrastructure allows much of this software and processing power to be centralised. The rollout of virtual simulation education packages is therefore simplified both in cost and complexity; learners simply participate online from any modern personal computer, without the need to install complex software on their computer.

The computer gaming industry has been the largest innovator and producer of these technologies and much can be learnt from what has been done before. Massively multiplayer online games (MMOG), in which many players, often numbering in the thousands, can interact in a permanent online virtual world, have existed for over a decade. The purpose of these games can vary. Some are traditional role playing games with player success being determined by objective goals to be accomplished, whereas others have no predefined goals, but merely serve as a medium where participants can interact with each other via avatars. In this social respect, they overlap extensively with traditional communities of people, whether physical or online, and in the process blur the boundary between game and reality. Perhaps the most well recognised example of this is the online game 'Second Life' by Linden Labs. 'Second Life' has already been used as a platform for medical education.

4. THE REQUIREMENTS

Simulation based training is a growing part of the training process for health professionals. By providing an online immersive training simulator for clinical decision making (a first for Australia), health professionals will be able to access training 24/7. The online immersive environment offers a very significant cost benefit over physical simulation training. It is not expected to replace the critical value of true hands-on training under expert supervision that the physical simulation facilities provide, its value is in augmenting physical facilities and resources and enabling a 24/7 solution to busy health professionals needing training and practice on-demand wherever they are.

Long-established modalities of learning where students are taught by specialist individuals within educational institutions have gradually moved to include the use of simulation education, but in recent times the focus has moved to communities of practice and of learning. This means a more experiential and collaborative basis that incorporates social media and communication rather than an internalized individual learning method.

Lev Vygotsky the early 20th century Russian psychologist suggested the concept of a zone of proximal development (ZPD) where a learner can progress the solution of a problem in collaboration with adult guidance or more capable peers. In the same vein, Lave and Wegner assert that mastery resides not in the teacher but in the organization of the community of practice.

Research in online learning has shown that students favour an environment that promotes discussion. Engaging online creates an opportunity to engage with peers in relation to the problem at hand which then allows for better critical thinking and thus more accurate decision making as reflected in real life work experience. This in turn has positive flow-on effects that can minimize problems with serendipitous clinical placement opportunities. This level of engagement builds the ability of students to understand clinical roles and responsibilities which has been shown to be a key area for miscommunication and misunderstanding.

In creating such a portal or online environment it is also vital to build appropriate support for the students' learning experience. It is not enough to merely focus on curriculum at the cost of a realistic experience or vice versa but a combination of both that are symbiotic within the greater structure of a community of practice. This concept is observed often in virtual simulation research that concerns itself more with the technological possibilities of the tool itself rather than the community it is based in. Often simulation based training seems dominated by technology therefore losing affinity with its original purpose in health and education.

For a student to feel comfortable with what they are learning and how they are progressing within set learning outcomes, their emotional needs must be met. Access to appropriate debriefing after virtual

simulations is vital as is the continued support of a mentor or facilitator who can both guide and encourage the student and intervene if an issue arises. Nevertheless a hidden problem can exist where there is a subjective vision of success and that a clinical need is being met purely because of the perception that a simulation centre or an online virtual experience by its very nature must meet these needs. This is where the strength of an online community lies in that not only does it provide a support network, engage students and promote participation and conversation, it can shape the user experience into skills and confidence that therefore apply in reality. Effectively, simulations should map real-life clinical experiences gained within communities of actual practice. These environments need to be motivational and learner centered which is essentially conducive to learning. Similarly, simply providing access to online content and simulations is not enough to guarantee effective learning. Regular reinforcement is of prime importance so that recently acquired skills are not lost.

5. PROJECT SCOPE

Although the rapid growth in information technology outlined earlier has opened up many possibilities for health education, it also poses significant new challenges. All too often, shiny innovations in technology per se have taken the focus away from the educational goals themselves. A high degree of psychological fidelity is required to adequately train cognitive and decision-making skills, the level of physical fidelity required to achieve this will vary with each situation. Too much physical detail in the wrong sections of a virtual environment (hyperfidelity) can actually impair rather than improve psychological fidelity. Conversely, too little or unrealistic animation will decrease the level of psychological immersion attained by students. Packages already in existence such as 'Second Life' have been used for health education as described before, particularly for their powerful community and collaboration aspects. By designing our own package (Nursim), we were able to exert more control over the details of the simulation, and in doing so achieve an appropriate but not distracting level of physical fidelity.

6. THE SOLUTION

Nursim combines the technological opportunity and the system-wide drive for solutions that are both economically valid and educationally relevant. We considered three main themes as most relevant to develop the best solution:

- Cognitive Structure
- Emotive immersion
- Supportive framework

The most constant component of simulation education is the development of appropriate clinical scenarios to best meet the learning objectives of the students. Whether presented at the bedside, in physical simulation centres, or in completely virtual environments, the learning material must be relevant and challenging but not overwhelming. Essential elements include case based learning, making decisions with regard to real-time clinical information presented to participants, and receiving real-time feedback with regard to consequences of their previous decisions. This narrative style of consequences immediately following actions is critical to learning, as it contextualises the role the learner plays in the scenario, and promotes reflection. Fortunately, extensive use of case based learning scenarios throughout health education already exists, and these have been applied to our virtual simulation scenarios.

As mentioned earlier, high physical fidelity can certainly improve immersion within virtual scenarios, but only if it is applied to appropriate sections of the simulation. Detailed and realistic graphical representation of real world objects and procedures should be saved for those elements of the simulation that demand more attention, focus and manipulation by the learners. In fact, attention to detail at these critical moments can drive psychological fidelity, enriching the learning experience for the learner. Ideally, analysis of the real world performance from a human factors perspective will crystalize the most important physical components of the work environment that need to be replicated with high physical fidelity in the virtual world. Unfortunately, there is a paucity of data in this area. Care must also be taken to ensure that learners, educators, and software developers appreciate that ultimately, an educational program's success is judged by achieving learning outcomes, and not by how photorealistic the virtual world was.

7. NURSIM – TYPICAL SCENARIOS

The use case presented focuses on delivering an immersive clinical decision training solution where trainees can log on and they will enter into a virtual hospital environment where they are greeted by a virtual

instructor, meet a patient and go through an assessment of the patient including observation and clinical decision making process where the patient gives common clues and the trainee must effectively question the patient and determine an effective course of action. Then the virtual instructor will give feedback. The instructor can also provide clues if needed by the trainee.

Standard clinical observation processes that will be supported include checking pulse, blood pressure, breathing, considering a patient's gestures that may reveal pain points and asking questions (based on a branching conversation model). The branching conversation model will be initially created by experienced simulation education staff and users will then be able to input new scenarios so that healthcare trainers, staff, students can all potentially develop and experiment with new scenarios and make them available to others to utilize.

This environment may also be used as a "free play" virtual role playing environment where multiple trainees and instructors can enter into the scene together and, using voice (VoIP) can talk together to run through a training exercise without requiring travel.

The architectural framework will provide:

- Private simulation training for healthcare students on-demand 24/7 from their homes. There are a number of aspects of this which are likely to be world-firsts
- Lower cost of providing a course of simulation-based training by having several sessions occurring online in a low cost online simulator and at least one session occurring in the physical simulators at CHI
- Prototype secure online immersive learning so that if successful, this can be more widely used to increase training capacity at a low cost of delivery.

The level of success of the environment as a clinical decision training solution hinges on the level of choice that the trainee has whilst in the simulation. The aim of the project is to create a responsive and as true-to-life

rendition of a set of circumstances as possible based on training for common errors.

Given the critical level of quality needed in applications such as training in health sector, the immersive quality of the experience is very important. This necessitates a larger set of high quality 3D models, textures and other data including streaming videos be transferred from the virtual world file server to participants in the immersive training session. Therefore good broadband networks are fundamental to delivering these learning outcomes.

CONCLUSION

This paper presents innovative technologies in social networking and immersive simulation which can provide significant benefits to Healthcare through a virtual world and community of practice solution which overcomes traditional barriers of firewalls and software downloads to enable rapid universal access to online services.

The principal outcome of this research is the design of an architectural framework to enable traditional 'face to face' services including complex team-based simulation training to be moved completely online, thus providing more automation as well as allowing greater accessibility on-demand to those who require it.

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